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# FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Sections:
ON: Fungi
Bryophytes &
Lichens

## on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl

| | |
|---|---|
| Lead Agencies: | U.S. Department of Agriculture<br>Forest Service |
| | U.S. Department of the Interior<br>Bureau of Land Management |
| Cooperating Agencies: | U.S. Department of the Interior<br>Fish and Wildlife Service<br>National Park Service |
| | U.S. Department of Commerce<br>National Oceanic & Atmospheric Administration<br>National Marine Fisheries Service |
| | U.S. Environmental Protection Agency |
| Responsible Officials: | Mike Espy<br>Secretary of Agriculture |
| | Bruce Babbitt<br>Secretary of the Interior |
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## Step 2. Describe in Detail the Basis for the Original Species Rating, and/or The Basis for Concern About Cumulative Effects

For each of the species selected in the above screens, a detailed description and interpretation was provided of the basis for the species' original rating in the FEMAT Report under Option 9. In the process of completing these descriptions, original assessment panel notes were consulted, as well as detailed maps of Alternative 9 and of species' ranges and locations; original literature sources for the species; and information on the portion of the species' range and/or locations included within reserves. Updated information was sought from State Natural Heritage Program data bases, and new herbarium searches were conducted for lichens.

The additional analysis for some species was more detailed than the original assessment, and/or included new information that was not reasonably available at the time of the original assessment. In some cases, this additional information provided the basis for reinterpreting the assessments in the FEMAT Report. Where this occurred, it is noted in the species discussions later in this chapter.

In developing the detailed species descriptions in this analysis, the SEIS Team considered the contribution that each of the following factors may have made to the original rating.

- **Natural history** - In some cases, the species may be known from only a few sites or from within a very limited distribution. In other cases, the species habitat, and thus its distribution, may be naturally fragmented.
- **Past actions** - In some cases, the species' habitat has been severely impacted/fragmented by previous actions, and can only recover slowly. In other cases, the species has already been extirpated from significant parts of its range, and recolonization is problematic.
- **Species' range** - A large portion of a species' range may lie outside the range of the northern spotted owl. In other cases, a large portion of a species' range may occur on nonfederal land.
- **Nonhabitat factors** - Factors such as hunting, fishing, air and water quality, and climate can influence the likely future for some species.
- **Inadequate information** - In some cases, the species' rating may be largely a reflection of scientific uncertainty due to the lack of available information about a species.
- **Features of the alternative** - The specific features of the alternatives were intended to play a primary role in determining the species' rating. For this analysis, the SEIS Team attempted to detail the specific features of the alternative that most influenced the original rating. This information is a critical building block for designing mitigation measures.

In addition to the above factors, the possible role of cumulative effects was examined for each species. This included species that were analyzed for a specific cumulative effect, as well as species that were analyzed based on other screens. Even though the original Assessment Team ratings of habitat outcomes for federal land were assigned largely independent of consideration of effects form management of nonfederal lands, the assessment panelists almost invariably also discussed other influences on some species in their panel workshops. In this most recent analysis, many of the discussions about cumulative effects and effects from nonfederal factors drew on the analysis of species' range and nonhabitat factors noted above.

Based on the above discussions, a summary statement was provided for each individual species report (Appendix J) that clarified the reasoning behind the species rating in the FEMAT Report. The summaries enabled the SEIS Team to distinguish between situations, for example, where a species received a particular rating because of naturally fragmented habitat, and situations where a species received a particular rating because the proposed action in the alternative was likely to further fragment its habitat.

## Step 3. Describe Possible Mitigation Measures

Mitigation as defined by the CEQ Regulations at 40 CFR 1508.20 includes a wide variety of measures taken to improve conditions for a potentially impacted landscape, species, community, or other part of the environment. Mitigation measures include: avoiding the impact altogether, minimizing the impact by limits on implementation, rectifying the impact by restoration or repair, reducing or eliminating the impact by preservation or maintenance, and finally, compensating for the impact by providing substitutes.

In a very real sense, all the alternatives in this SEIS are, among other things, compilations and combinations of mitigation measures; all the allocations and standards and guidelines are designed to manage federal lands at different levels of risk or impact to forest ecosystems and human communities. Some of the allocations and standards and guidelines are common to more than one alternative; some could be added to existing alternatives to create yet another alternative which would mitigate one type of impact (but with a possible adverse effect on another part of the environment).

The additional species analysis that was conducted between the Draft and Final SEIS considered the incorporation of the additional standards and guidelines added to Alternative 9. These (and other) standards and guidelines could be added to any of the alternatives and result in additional beneficial impacts on species or forest ecosystems for them as well. However, if all standards and guidelines were added to all alternatives, they would be very similar, and not represent a range of alternatives.

In addition to these standards and guidelines that appear in at least one other alternative, there were measures considered that do not appear in any alternative. They could be included, if practicable, in any alternative. They are identified later in the chapter as possible mitigation measures for the species that they would most clearly benefit.

Possible mitigation measures were developed in conjunction with advice from species experts. The mitigation measures were designed primarily to modify features of Alternative 9. In many cases, the possible measures would adopt some component of another alternative in which the species outcome rated higher. In other cases, the mitigation measure would prescribe actions to be taken when very localized actions are planned. These mitigation measures were intended to address the rare and narrowly-distributed species. Finally, some mitigation measures were intended to offset the possible negative consequences of cumulative effects.

In all cases, evaluation of mitigation measures was done to determine if they would bring the species to a point where it would pass through all the screens described in Step 1, above. While the species analyzed were not rated again, the mitigation measures were designed to address aspects of the alternative that were adverse to the species and which were reflected in the FEMAT Report ratings. Where species outcomes did not respond sufficiently to pass through all the screens, it is stated (see the individual species discussions later in this chapter and Appendix J). In these cases, possible mitigation measures have been presented that would provide some benefit to the species. Mitigation measures have been described as specifically as possible to help display the benefits of the mitigation.

### MITIGATION MEASURES CONSIDERED

The following possible mitigation measures were developed during the species analysis process (described above) and benefits to species were considered. These possible mitigation measures may provide additional benefits to species under all alternatives. Those mitigation measures incorporated into Alternative 9 as standards and guidelines are in bold typeface (see Appendix B11 for full description). The effects on species are described in the individual species discussions later in this chapter.

#### Survey and Manage Measures

- **Protect known locations**
- **Survey and manage**

#### Riparian Reserves

- **Apply Riparian Reserve Scenario I**
    - In small wetlands
    - In the range of amphibians
    - In the range of coho salmon
    - **Throughout the range of the northern spotted owl**
- **Ensure riparian protection in Adaptive Management Areas**

#### Watershed Protections

- Remove Tier 1 Key Watersheds from programmed harvest
- Build no new roads in Tier 1 Key Watersheds
- Remove inventoried roadless areas (RARE II) from programmed harvest

#### Matrix Management Provisions

- **Provide coarse woody debris**
- **Emphasize clumped green tree/snag retention**
- **Provide buffers around caves**

- Modify site treatments
- Protect old-growth fragments where scarce

**Northern Spotted Owl Measures**

- Retain nest sites
- Manage the landscape for dispersal habitat

**Marbled Murrelet Measures**

- Retain old-growth forest in Marbled Murrelet Zone 1

**Other measures**

- Protect sites from grazing
- Manage impacts in recreation areas
- Identify species-specific measures

### Step 4. Describe the Benefits of the Mitigation Measures

Qualitative statements about the efficacy of mitigation are provided in the individual species analyses in Appendix J. Wherever possible, information on the effectiveness of individual mitigation actions is provided, and is displayed in the individual species discussions later in this chapter.

# SPECIES NOT THREATENED OR ENDANGERED

## Nonvascular Plants and Allies

**BRYOPHYTES**

### Affected Environment

Hornworts, liverworts, and mosses (collectively known as bryophytes) are small, green, nonvascular, spore-bearing plants that include a wide array of species well adapted to nearly every habitat on earth. About 170 species of liverworts and 450 species of mosses occur within the range of the northern spotted owl. About 20 percent of these species are endemic to western North America or the Pacific Northwest (Lawton 1971).

See the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment, for a more in-depth discussion of the affected environment.

### Environmental Consequences

**METHODS SPECIFIC TO BRYOPHYTES**

An assessment panel evaluated 106 species that were considered to be closely associated with late-successional and old-growth forests, including 32 species endemic to western North America or the Pacific Northwest (FEMAT Report, Table IV-A-3, p. IV-223). Bryophytes were divided into 13 habitat groups to facilitate discussion (Table 3&4-22). Groups were based on ecological relationships or habitat associations, and some of the groups were further subdivided by their degree of rarity. Ratings were based on the likelihood of an alternative providing habitat conditions to support various population distributions on federal lands for the bryophyte species.

Three species were rated individually because they did not readily fit into species groups or were too poorly known, and eight were rated individually because they are rare species. See the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment for a more detailed description of methods. There were 16 species not rated because of insufficient information. Because little is known about the distribution and habitat requirements of these species, there is uncertainty of the effects of forest management activities to habitats supporting these species. Generally the alternatives that manage for more extensive and interconnected late-successional and old-growth forested conditions will minimize the risks to these species. While there is a risk that these species could be harmed by a variety of factors, including federal forest management activities, the relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. Should habitat conditions decline significantly from projections, or should additional scientific information regarding the serious decline of these species become available, management of the relevant area would be considered for change under the adaptive management process described in Chapter 2.

There were 13 species groups and 12 species assessed in the FEMAT Report. Of these, nine bryophytes (three mosses and six liverworts) were subject to additional analysis as described earlier in Chapter 3&4, Methods for Additional Species Analysis. Two species from the Canopy-Branch, Interior species group (*Antitrichia curtipendula, Douinia ovata*) were individually analyzed because of concerns about possible effects from management of nonfederal lands, and *Scouleria marginata* was also analyzed because of concerns about cumulative effects. One species (*Ptilidium californicum*) was analyzed due to the adjustment of the harvest rotation length in California under Alternative 9 between the Draft and Final SEIS. Four species (*Kurzia makinoana, Tritomaria exsectiformis, Marsupella emarginata* var. *aquatica*, and *Diplophyllum plicatum*) were analyzed because of their ratings in the FEMAT Report. Although *Thamnobryum neckeroides* met the criterion for additional analysis described in the section Methods for Additional Species Analysis, it was dropped from further analysis because it was found not to be closely associated with late-successional and old-growth forests.

**EFFECTS OF ALTERNATIVES** Results for the bryophytes for all alternatives are shown in Table 3&4-22. The species shown in the shaded portion of the table are those that were specifically considered when additional standards and guidelines were added to Alternative 9. The additional standards and guidelines incorporated into Alternative 9 (see Appendix B11) would increase habitat protection for several of these species. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-22 have not been changed to reflect these and other additions to the alternative.

## Table 3&4-22 Projected future likelihood for bryophytes habitat outcomes under land management alternatives in the Draft SEIS

| | Alternative 1 | | | | Alternative 3 | | | | Alternative 4 | | | | Alternative 5 | | | | Alternative 7 | | | | Alternative 8 | | | | Alternative 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Bryophytes** | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D |
| **Individual Species;** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Blindia flexipoda | 80 | 20 | 0 | 0 | 70 | 30 | 0 | 0 | 80 | 20 | 0 | 0 | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 60 | 40 | 0 | 0 | 80 | 20 | 0 | 0 |
| Diplophyllum plicatum | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 | 10 | 30 | 30 | 30 |
| Fontinalis howellii | 97 | 3 | 0 | 0 | 93 | 7 | 0 | 0 | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 77 | 23 | 0 | 0 | 73 | 27 | 0 | 0 | 90 | 10 | 0 | 0 |
| Kurzia makinoana | 100 | 0 | 0 | 0 | 91 | 3 | 3 | 3 | 91 | 3 | 3 | 3 | 91 | 3 | 3 | 3 | 82 | 6 | 6 | 6 | 82 | 6 | 6 | 6 | 91 | 3 | 3 | 3 |
| Marsupella emarginata var. aquatica | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 | 0 | 30 | 60 | 10 |
| Pseudoleskeella serpentinense (CA) | 100 | 0 | 0 | 0 | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 80 | 20 | 0 | 0 | 90 | 10 | 0 | 0 |
| Ptilidium californicum (CA only) | 100 | 0 | 0 | 0 | 90 | 10 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 100 | 0 | 0 | 0 |
| Racomitrium pacificum | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 | 0 | 0 | 50 | 50 | 0 | 0 | 50 | 50 | 0 | 0 | 70 | 30 | 0 | 0 |
| Schistostega pennata (WA only) | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 100 | 0 | 0 | 0 |
| Scouleria marginata | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 100 | 0 | 0 | 0 |
| *Thamnobryum neckeroides*[1] | 70 | 13 | 17 | 0 | 67 | 13 | 20 | 0 | 67 | 13 | 20 | 0 | 60 | 20 | 20 | 0 | 53 | 23 | 20 | 3 | 53 | 17 | 20 | 10 | 60 | 20 | 20 | 0 |
| Tritomaria exsectiformis | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 |
| **Bryophyte Groups** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Abundant Decaying Wood | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 97 | 3 | 0 | 0 | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 73 | 27 | 0 | 0 | 97 | 3 | 0 | 0 |
| Aquatic | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 100 | 0 | 0 | 0 | 87 | 13 | 0 | 0 | 80 | 20 | 0 | 0 | 77 | 23 | 0 | 0 | 97 | 3 | 0 | 0 |
| Canopy-Branch, Interior | 77 | 23 | 0 | 0 | 73 | 27 | 0 | 0 | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 63 | 37 | 0 | 0 | 73 | 27 | 0 | 0 |
| Canopy-Twigs, Exterior | 95 | 5 | 0 | 0 | 95 | 5 | 0 | 0 | 95 | 5 | 0 | 0 | 95 | 5 | 0 | 0 | 95 | 5 | 0 | 0 | 65 | 35 | 0 | 0 | 95 | 5 | 0 | 0 |
| Decaying Wood | 93 | 7 | 0 | 0 | 87 | 13 | 0 | 0 | 87 | 13 | 0 | 0 | 83 | 17 | 0 | 0 | 77 | 23 | 0 | 0 | 73 | 27 | 0 | 0 | 90 | 10 | 0 | 0 |
| Flood Plain | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 97 | 3 | 0 | 0 | 90 | 10 | 0 | 0 | 77 | 23 | 0 | 0 | 77 | 23 | 0 | 0 | 97 | 3 | 0 | 0 |
| Shaded Duff/Humic Soil | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 93 | 7 | 0 | 0 | 100 | 0 | 0 | 0 |
| Shaded Mineral Soil | 87 | 13 | 0 | 0 | 83 | 17 | 0 | 0 | 83 | 17 | 0 | 0 | 83 | 17 | 0 | 0 | 80 | 20 | 0 | 0 | 77 | 23 | 0 | 0 | 87 | 13 | 0 | 0 |
| Shaded Rock Outcrops | 93 | 7 | 0 | 0 | 80 | 20 | 0 | 0 | 77 | 23 | 0 | 0 | 73 | 27 | 0 | 0 | 67 | 30 | 3 | 0 | 60 | 37 | 3 | 0 | 83 | 17 | 0 | 0 |
| Splash Zone | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 83 | 17 | 0 | 0 | 83 | 17 | 0 | 0 | 100 | 0 | 0 | 0 |
| Tree Boles/Decaying Wood | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 100 | 0 | 0 | 0 |
| Tree Boles/Understory | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 83 | 17 | 0 | 0 | 80 | 17 | 3 | 0 | 90 | 10 | 0 | 0 |
| Wet Shaded Humic Soil | 100 | 0 | 0 | 0 | 97 | 3 | 0 | 0 | 97 | 3 | 0 | 0 | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 80 | 20 | 0 | 0 | 93 | 7 | 0 | 0 |

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

[1] Species dropped from original assessment.

Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.

The habitat components important to bryophytes include live, old-growth trees, decaying wood, riparian zones and generally the habitat characteristics achieved by more extensive and interconnected late-successional and old-growth forested conditions. Alternatives 1, 3, and 9, are generally the most favorable to bryophytes because they provide the set of allocations and management practices that best produce the habitat components for bryophytes. Alternatives 4, 5, 7 and 8, respectively, provide less of these habitat conditions. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

Ratings were the same under all alternatives for three species (*Tritomaria exsectiformis*, *Marsupella emarginata* var. *aquatica*, and *Diplophyllum plicatum*) due to the rarity of these species. No standards and guidelines could be described that would avoid all risk of extirpation to these species on federal lands.

For the remaining 21 species or groups, all rated alternatives would provide 88 percent or greater likelihood of providing habitat of sufficient quality, distribution, and abundance to support stable populations either well distributed when measured against their historic range or distributed with gaps in their historic distribution on federal land.

For those 21 species, Alternatives 1, 3, and 9 consistently rated higher than others. Alternative 1 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 17 bryophyte species or species groups, 80 to 89 percent likelihood for two bryophyte species or species groups, and 70 to 79 percent likelihood for two bryophyte species or species groups. With the additional standards and guidelines incorporated between Draft and Final SEIS, Alternative 9 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 16 bryophyte species or species groups, 80 to 89 percent likelihood for 3 bryophyte species or species groups, and 70 to 79 percent likelihood for 2 species or species groups. Alternative 3 would provide 90 percent or greater likelihood of providing sufficient habitat to support stable populations, well distributed when measured against their historic range across federal lands for 15 bryophyte species or species groups, 80 to 89 percent likelihood for three bryophyte species or species groups, and 70 to 79 percent likelihood for three bryophyte species or species groups. Alternatives 4, 5, 7, and 8, respectively, have decreasing likelihoods of providing this habitat condition, as displayed in Table 3&4-22.

A number of species would benefit from the addition of standards and guidelines to Alternative 9. *Antitrichia curtipendula* and *Douinia ovata* would be benefited by the addition of Riparian Reserve Scenario 1. *Kurzia makinoana* would benefit from a combination of Riparian Reserve Scenario 1, provisions for coarse woody debris and green-tree retention, and provisions to retain old-growth fragments in watersheds where less than 15 percent late-successional forest remains. *Ptilidium californicum* would benefit from a combination of protection of known sites, provisions for coarse woody debris and green-tree retention, provisions to retain old-growth fragments, and provisions to provide 100-acre habitat areas around spotted owl activity centers. *Scouleria marginata* would receive additional habitat protection from Riparian Reserve Scenario 1, and further provisions for riparian management in Adaptive Management Areas.

Standards and guidelines were added to Alternative 9 for the three species described above (*Tritomaria exsectiformis, Marsupella emarginata* var. *aquatica,* and *Diplophyllum plicatum*). While these standards and guidelines would not avoid all risk of extirpation from federal lands, they would benefit these species. *Tritomaria exsectiformis* would benefit from Riparian Reserve Scenario 1 and also from protection of known locations from grazing. *Marsupella emarginata* var. *aquatica* would benefit from protection of the single site from which it is known, and which receives heavy recreational use. *Diplophyllum plicatum* would benefit from measures that provide for coarse woody debris in the matrix.

## POSSIBLE MITIGATION MEASURES

All of the alternatives contain standards and guidelines that are expected to benefit bryophytes. As noted previously in this chapter, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines which would retain live, old-growth trees, decaying wood, and riparian zones would be of greatest benefit to the bryophytes.

The following possible mitigation measures are not represented in the alternatives, but could benefit bryophytes:

Commercial moss collecting could be regulated in any of the alternatives to prevent overharvest.

Additional forest land along the coast could be managed for old-growth Sitka spruce.

Cold springs could be recognized as important resources for biological diversity.

Ensure that water pollution from sewage and motorboats at Waldo Lake does not negatively impact the population of *Marsupella emarginata* var. *aquatica*.

For *Schistostega pennate,* windfalls could be left in place to provide structurally diversehabitat.

Green trees should be retained along fog-drenched ridges (in stand sizes sufficient to withstand windthrow) for maintenance of biological diversity.

### CUMULATIVE EFFECTS INCLUDING THE ROLE OF NONFEDERAL LANDS

There is little habitat for late-successional and old-growth bryophyte species on private lands in the region. Most of the old-growth coniferous forest on private lands within the range of the northern spotted owl has been logged, and the landscape currently is being managed on relatively short (30 to 70-year) rotations. Cumulative effects due to conditions on nonfederal lands were judged to be especially important for three species (*Diplophyllum plicatum, Ptilidium californicum* and *Scouleria marginata*).

Bryophytes are sensitive to air quality, especially acid deposition and particulate matter; potential declines in air quality may cause significant population losses to these species. The bryophytes of the aquatic habitat group are affected by sedimentation, temperature change, hydroelectric projects, mining, recreational development, and nonpoint source pollution that can occur on state and private lands. Two species, *Antitrichia curtipendula* and *Diplophyllum plicatum*, are especially sensitive to air quality effects.

State lands, especially state parks , provide habitat for some bryophytes, particularly in the coastal Sitka spruce region. Many of these parks contain the last remnants of old-growth coastal Sitka spruce forests within the range of the northern spotted owl. Saddle Mountain State Park in Oregon, which is characterized by a high peak with a fog-drenched summit, hosts some of the rarest bryophytes in the Pacific Northwest. Unfortunately, these sites also may be impacted by declining air quality, although not so severely as parks in the interior valleys or foothills of the Cascade Range.

### FUNGI

## Affected Environment

Fungi are neither plants nor animals but are recognized as a separate kingdom of organisms, both in structure and function. The large number of macrofungi in late-successional and old-growth forests, especially those of uneven-age structure, reflects the complexity of the late-successional and old-growth ecosystems as well as, or better than, many other groups of organisms. Estimates indicate there are at least six species of fungi for every vascular plant species in a given temperate ecosystem (Hawksworth 1991).

The fungal flora of the Pacific Northwest is extremely diverse. Of the 527 species of fungi that were evaluated as closely associated with late-successional and old-growth forests, 109 (21 percent) are known to be endemic to the Pacific Northwest (Ammirati, J. pers. comm.). This list of species represents only a small percentage of the macrofungi that occur in late-successional forests. If microfungi were included, the list would be greatly expanded. For every group of fungi, there are many species, perhaps hundreds, in addition to those on the original list (see FEMAT Report, Table IV-A-1, p. IV-213).

Fungi are essential to the functioning of forest ecosystems. Many of the forest fungi that produce large fruiting bodies (e.g., mushrooms, boletes, corals) have symbiotic relationships with vascular plants. The survival of most conifers and many flowering plants depends on associations with these mycorrhizal fungi for the uptake of nutrients and water (Trappe and Luoma 1992). Hypogeous fungi (fungi that fruit below ground) and certain mushrooms are important food for small mammals that, in turn, aid in spore dispersal. These small mammals are also the major prey of northern spotted owls over much of their range (Maser et al. 1978, Ure and Maser 1982). Saprobic fungi (fungi that live on dead or decaying organic matter) are a major component of all forest ecosystems, growing on recently fallen trees, well-decayed logs, litter, dung, etc. They play an important role in decomposition and nutrient recycling. For a fuller discussion see the FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment.

## Environmental Consequences

### METHODS SPECIFIC TO FUNGI

A list of 527 fungi species closely associated with late-successional and old-growth forests on federal lands within the geographic range of the northern spotted owl was developed following the criteria used for the Scientific Analysis Team Report (Thomas et al. 1993). While not complete, the list suggests the high biological diversity of fungi that exists in late-successional and old-growth forests of the Pacific Northwest. Because there is little published information on the diversity of fungi for the old-growth forests of the Pacific Northwest, mycologists contributed to the development of this list based on their research and field experience throughout the region (FEMAT Report).

The assessment panel evaluated all 527 taxa of fungi (FEMAT Report, Table IV-A-1, p. IV-213). Two major functional divisions of fungi were identified: the ecto-mycorrhizal fungi, and the decomposers or saprobes. Several parasitic species were also included. Overall, the species were divided into 36 groups, based on taxonomic and ecological relationships, as well as their degree of rarity. The species of greatest concern for risk of extirpation were the rare or locally-distributed fungi that comprised 28 percent of the species evaluated.

Each species group was discussed by the assessment panel, and fungi species were added or deleted. Groups of species were finalized based on similarity in response to habitat provided on federal lands by the various management alternatives. The ratings for each group were based on the likelihood of an alternative providing habitat conditions to support various population distributions on federal lands for the fungi (Outcomes A-D, see discussion of assessment panels earlier in this chapter). Twelve species were treated individually because of differences in their biological or ecological attributes. Four species were not evaluated by the assessment panel because of insufficient information and uncertainty about their biology and ecology. In addition, three orders of microfungi representing hundreds of species were discussed by the assessment panel but not evaluated because of lack of information (FEMAT Report, Chapter IV, Terrestrial Forest Ecosystem Assessment). Since little is known about the distribution and habitat requirements of these species, there is uncertainty surrounding the effects of forest management activities to habitats supporting these species. Generally, the alternatives that provide for more extensive and interconnected late-successional and old-growth forested conditions would minimize the risks to these species. The relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. If habitat conditions decline significantly from projections, or if additional scientific information indicates a serious decline of these species' populations, a change of management of the relevant area would be considered under the adaptive management process described in the implementation section of this Final SEIS.

A summary of outcome scores for each group or species of fungi was based on the average scores of the three panelists (Table 3&4-23). See also the general discussion of viability analysis assumptions and the process for evaluating and describing the results earlier in this chapter.

There were 255 species of fungi subject to additional analysis between the Draft and Final SEIS (see Methods for Additional Species Analysis in this Chapter). The additional analysis considered each species separately rather than in the groups that were used for the initial rating. Of the total analyzed, 210 species were analyzed because of their initial rating in the FEMAT Report. Sixteen species were given additional review based on cumulative effects. One species was included in the additional analysis because of changes in Alternative 9. Five species (including two species of *Gastroboletus* examined separately out of the boletes group) received additional review both because of the change in the 180-year harvest rotation in California, and either their initial rating in the FEMAT Report or cumulative effects. An additional eight species were analyzed based on additional information not available at the time of the original rating. Fifteen species from the original Assessment Team list were dropped from the original assessment based on additional information which indicated those species did not meet the criterion of being closely associated with old-growth. The species that were analyzed represent the broad spectrum of fungi that occur in late-successional forest ecosystems, including mycorrhizal, saprobic and parasitic species. A full list of the species analyzed and discussion of the analysis is enclosed in Appendix J.

Additional analysis for the Final SEIS resulted in a number of corrections or changes from the FEMAT Report and Draft SEIS. These changes primarily involved moving species from one of the groups displayed in the original FEMAT Report to another group. When species were moved, they generally assumed the rating of the new group. These changes are discussed in detail in Appendix J.

### EFFECTS OF ALTERNATIVES

Results for the fungi across all alternatives are shown in Table 3&4-23. The species or species' ranges shown in the shaded portion of Table 3&4-23 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-23 have not been changed to reflect these additions to the alternative.

Species diversity of fungi appears highest in late-successional forests because of the diversity of habitat structures and host species, and the abundance of coarse woody debris and standing dead trees. Habitat components important to the fungi include dead, down wood; standing dead trees; and live, old-growth trees; as well as a diversity of host species and microhabitats. Also important for fungi is a well-distributed network of late-successional forest. Small forest fragments can function as refugia where fungi may persist until

### Table 3&4-23. Projected future likelihood for fungi habitat outcomes under land management alternatives in the Draft SEIS

| | Alternative 1 | | | | Alternative 3 | | | | Alternative 4 | | | | Alternative 5 | | | | Alternative 7 | | | | Alternative 8 | | | | Alternative 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fungi | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D |
| Mycorrhizal | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bolete-GARU, Rare | 83 | 10 | 7 | 0 | 77 | 15 | 8 | 0 | 73 | 17 | 10 | 0 | 67 | 22 | 8 | 3 | 67 | 22 | 8 | 3 | 63 | 22 | 12 | 3 | 67 | 22 | 8 | 3 |
| Bolete/False Truffles, Rare (3 species) | 0 | 3 | 91 | 5 | 0 | 2 | 92 | 7 | 0 | 2 | 88 | 10 | 0 | 2 | 83 | 15 | 0 | 2 | 82 | 17 | 0 | 2 | 82 | 17 | 0 | 2 | 83 | 15 |
| Boletes (13 species) | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 77 | 23 | 0 | 0 | 67 | 33 | 0 | 0 | 67 | 33 | 0 | 0 | 67 | 33 | 0 | 0 | 70 | 30 | 0 | 0 |
| Boletes, Low Elevation (2 species) | 20 | 53 | 27 | 0 | 20 | 43 | 37 | 0 | 20 | 43 | 37 | 0 | 17 | 47 | 37 | 0 | 17 | 47 | 37 | 0 | 17 | 43 | 40 | 0 | 17 | 43 | 40 | 0 |
| Boletes, Rare (2 species) | 13 | 67 | 17 | 3 | 8 | 65 | 22 | 5 | 8 | 57 | 30 | 5 | 3 | 52 | 33 | 12 | 2 | 52 | 28 | 18 | 3 | 48 | 28 | 20 | 2 | 52 | 28 | 18 |
| Chanterelle-CAFO, Rare | 33 | 33 | 28 | 5 | 27 | 35 | 33 | 5 | 22 | 37 | 35 | 7 | 13 | 37 | 32 | 18 | 10 | 30 | 38 | 22 | 0 | 30 | 38 | 22 | 10 | 33 | 38 | 18 |
| Chanterelle-POMU, Rare | 40 | 47 | 10 | 3 | 33 | 52 | 12 | 3 | 35 | 45 | 17 | 3 | 27 | 45 | 20 | 8 | 17 | 50 | 25 | 8 | 20 | 43 | 27 | 10 | 22 | 43 | 27 | 8 |
| Chanterelles (3 species) | 73 | 27 | 0 | 0 | 73 | 27 | 0 | 0 | 63 | 37 | 0 | 0 | 57 | 43 | 0 | 0 | 60 | 40 | 0 | 0 | 57 | 43 | 0 | 0 | 60 | 40 | 0 | 0 |
| Chanterelles-Gomphus (4 species) | 83 | 13 | 3 | 0 | 77 | 15 | 8 | 0 | 68 | 20 | 10 | 2 | 62 | 23 | 12 | 3 | 53 | 25 | 18 | 3 | 53 | 23 | 20 | 3 | 57 | 22 | 18 | 3 |
| Coral Fungi (50+ species) | 85 | 10 | 5 | 0 | 80 | 10 | 10 | 0 | 70 | 18 | 10 | 3 | 60 | 18 | 15 | 8 | 55 | 20 | 18 | 8 | 50 | 23 | 20 | 8 | 55 | 20 | 18 | 8 |
| Ecto-Puffballs (2 species) | 93 | 7 | 0 | 0 | 90 | 10 | 0 | 0 | 87 | 13 | 0 | 0 | 80 | 20 | 0 | 0 | 73 | 23 | 3 | 0 | 77 | 23 | 0 | 0 | 80 | 20 | 0 | 0 |
| Ecto-Polypores, Rare (3 species) | 10 | 50 | 37 | 3 | 7 | 52 | 35 | 7 | 8 | 43 | 38 | 10 | 3 | 42 | 37 | 18 | 2 | 42 | 35 | 22 | 3 | 38 | 38 | 20 | 2 | 42 | 38 | 18 |
| Ecto-Polypore, Uncommon (2 species) | 70 | 20 | 10 | 0 | 60 | 25 | 15 | 0 | 53 | 27 | 20 | 0 | 42 | 32 | 20 | 7 | 40 | 30 | 23 | 7 | 38 | 32 | 23 | 7 | 42 | 32 | 20 | 7 |
| Ecto-Polypore-COPE | 93 | 7 | 0 | 0 | 93 | 7 | 0 | 0 | 87 | 13 | 0 | 0 | 83 | 17 | 0 | 0 | 80 | 20 | 0 | 0 | 80 | 20 | 0 | 0 | 83 | 17 | 0 | 0 |
| Ecto-Resupinate Fungi (3 species) | 97 | 3 | 0 | 0 | 97 | 3 | 0 | 0 | 93 | 7 | 0 | 0 | 87 | 13 | 0 | 0 | 83 | 17 | 0 | 0 | 83 | 17 | 0 | 0 | 87 | 13 | 0 | 0 |
| False Truffle-MALY, Rare | 8 | 10 | 75 | 7 | 7 | 10 | 75 | 8 | 5 | 12 | 72 | 12 | 2 | 12 | 72 | 15 | 0 | 10 | 72 | 18 | 0 | 12 | 70 | 18 | 0 | 12 | 72 | 17 |
| False Truffles (18 species) | 95 | 5 | 0 | 0 | 85 | 15 | 0 | 0 | 80 | 15 | 5 | 0 | 70 | 20 | 10 | 0 | 50 | 30 | 20 | 0 | 55 | 25 | 20 | 0 | 55 | 25 | 20 | 0 |
| False Truffles, Rare (22 species) | 20 | 30 | 40 | 10 | 15 | 35 | 40 | 10 | 15 | 35 | 40 | 10 | 5 | 35 | 50 | 10 | 0 | 35 | 50 | 15 | 0 | 35 | 50 | 15 | 0 | 35 | 50 | 15 |
| False Truffles, Uncommon (4 species) | 30 | 40 | 30 | 0 | 25 | 40 | 35 | 0 | 25 | 35 | 35 | 5 | 25 | 30 | 40 | 5 | 15 | 25 | 40 | 20 | 20 | 30 | 40 | 10 | 20 | 30 | 40 | 10 |
| Gilled Mushroom-CHLO, Rare | 0 | 3 | 91 | 5 | 0 | 2 | 92 | 7 | 0 | 2 | 88 | 10 | 0 | 2 | 83 | 15 | 0 | 2 | 82 | 17 | 0 | 2 | 82 | 17 | 0 | 2 | 83 | 15 |
| Gilled Mushrooms (125 species) | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 73 | 23 | 3 | 0 | 63 | 33 | 3 | 0 | 60 | 33 | 7 | 0 | 63 | 30 | 7 | 0 | 67 | 27 | 7 | 0 |
| Gilled Mushrooms, Rare (6 species) | 20 | 60 | 15 | 5 | 15 | 65 | 15 | 5 | 10 | 58 | 25 | 8 | 5 | 50 | 28 | 18 | 5 | 45 | 28 | 23 | 5 | 45 | 30 | 20 | 5 | 50 | 28 | 18 |
| Gilled Mushrooms, Uncommon (13 species) | 65 | 25 | 10 | 0 | 60 | 30 | 10 | 0 | 50 | 33 | 18 | 0 | 40 | 35 | 15 | 10 | 40 | 30 | 15 | 15 | 35 | 30 | 20 | 15 | 40 | 30 | 15 | 15 |
| Phaeocollybia (13 species) | 70 | 23 | 7 | 0 | 63 | 30 | 7 | 0 | 53 | 37 | 10 | 0 | 47 | 38 | 10 | 5 | 40 | 35 | 15 | 10 | 42 | 38 | 15 | 5 | 45 | 38 | 12 | 5 |
| Tooth Fungi (5 species) | 93 | 7 | 0 | 0 | 83 | 17 | 0 | 0 | 73 | 23 | 3 | 0 | 73 | 33 | 3 | 0 | 60 | 33 | 7 | 0 | 63 | 30 | 7 | 0 | 67 | 27 | 7 | 0 |
| Truffles (5 species) | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 85 | 15 | 0 | 0 | 80 | 20 | 0 | 0 | 75 | 25 | 0 | 0 | 75 | 25 | 0 | 0 | 75 | 25 | 0 | 0 |
| Truffles, Rare (5 species) | 10 | 20 | 60 | 10 | 8 | 23 | 60 | 10 | 8 | 20 | 58 | 15 | 3 | 20 | 60 | 18 | 0 | 18 | 55 | 28 | 0 | 15 | 60 | 25 | 0 | 18 | 60 | 23 |
| Truffles-TURU | 10 | 30 | 40 | 20 | 5 | 28 | 40 | 28 | 0 | 33 | 40 | 28 | 0 | 33 | 40 | 28 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 | 0 | 30 | 40 | 30 |
| Undescribed Taxa, Rare (29 species) | 0 | 10 | 80 | 10 | 0 | 10 | 70 | 20 | 0 | 10 | 60 | 30 | 0 | 0 | 60 | 40 | 0 | 0 | 50 | 50 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 |
| Zygomycetes, Rare (3 species) | 10 | 20 | 60 | 10 | 8 | 23 | 60 | 10 | 8 | 20 | 58 | 15 | 3 | 20 | 60 | 18 | 0 | 18 | 55 | 28 | 0 | 15 | 60 | 25 | 0 | 18 | 60 | 23 |
| Parasitic | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Cauliflower Mushroom | 83 | 13 | 3 | 0 | 80 | 15 | 5 | 0 | 73 | 20 | 7 | 0 | 67 | 25 | 5 | 3 | 60 | 25 | 12 | 3 | 63 | 25 | 8 | 3 | 67 | 25 | 5 | 3 |
| Parasitic Fungi (7 species) | 65 | 25 | 10 | 0 | 60 | 30 | 10 | 0 | 50 | 28 | 23 | 0 | 40 | 30 | 25 | 5 | 35 | 30 | 25 | 10 | 35 | 30 | 30 | 5 | 40 | 30 | 25 | 5 |
| Parasitic Fungi, Common (2 species) | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 80 | 20 | 0 | 0 | 75 | 25 | 0 | 0 | 70 | 30 | 0 | 0 | 70 | 30 | 0 | 0 | 75 | 25 | 0 | 0 |

## Table 3&3-23. Projected future likelihood for fungi habitat outcomes under land management alternatives in the Draft SEIS

| | Alternative 1 | | | | Alternative 3 | | | | Alternative 4 | | | | Alternative 5 | | | | Alternative 7 | | | | Alternative 8 | | | | Alternative 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fungi (continued) | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D |
| **Saprobic - (Decomposers)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Branched Coral Fungi (3 species) | 90 | 10 | 0 | 0 | 85 | 15 | 0 | 0 | 75 | 25 | 0 | 0 | 65 | 35 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 | 0 | 0 | 65 | 35 | 0 | 0 |
| Cup Fungi (15 species) | 90 | 10 | 0 | 0 | 90 | 10 | 0 | 0 | 80 | 20 | 0 | 0 | 70 | 30 | 0 | 0 | 65 | 35 | 0 | 0 | 65 | 35 | 0 | 0 | 70 | 30 | 0 | 0 |
| Cup Fungi, Rare (14 species) | 15 | 40 | 28 | 18 | 10 | 40 | 33 | 18 | 0 | 45 | 35 | 20 | 0 | 35 | 38 | 28 | 0 | 35 | 38 | 28 | 0 | 30 | 38 | 33 | 0 | 35 | 38 | 28 |
| Gilled Mushrooms (80 species) | 90 | 10 | 0 | 0 | 85 | 15 | 0 | 0 | 75 | 25 | 0 | 0 | 65 | 35 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 | 0 | 0 | 65 | 35 | 0 | 0 |
| Gilled Mushrooms, Rare (6 species) | 10 | 55 | 25 | 10 | 10 | 50 | 25 | 15 | 3 | 50 | 30 | 18 | 0 | 40 | 38 | 23 | 0 | 35 | 43 | 23 | 0 | 35 | 40 | 25 | 0 | 40 | 38 | 23 |
| Gilled Mushrooms, Uncommon (17 species) | 65 | 30 | 5 | 0 | 60 | 30 | 10 | 0 | 50 | 33 | 18 | 0 | 40 | 35 | 15 | 10 | 35 | 35 | 15 | 15 | 35 | 35 | 20 | 10 | 40 | 35 | 15 | 10 |
| Jelly Mushroom | 60 | 35 | 5 | 0 | 55 | 35 | 10 | 0 | 55 | 33 | 13 | 0 | 35 | 30 | 25 | 10 | 35 | 25 | 25 | 15 | 30 | 30 | 30 | 10 | 35 | 30 | 25 | 10 |
| Oxyporus nobilissimus | 18 | 28 | 37 | 17 | 13 | 28 | 40 | 18 | 10 | 28 | 47 | 15 | 10 | 25 | 43 | 22 | 7 | 22 | 47 | 25 | 10 | 25 | 40 | 25 | 10 | 25 | 43 | 22 |
| Polypores (10 species) | 90 | 10 | 0 | 0 | 85 | 15 | 0 | 0 | 75 | 25 | 0 | 0 | 65 | 35 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 | 0 | 0 | 65 | 35 | 0 | 0 |
| Resupinate Fungi (14 species) | 90 | 10 | 0 | 0 | 85 | 15 | 0 | 0 | 75 | 25 | 0 | 0 | 65 | 35 | 0 | 0 | 60 | 40 | 0 | 0 | 60 | 40 | 0 | 0 | 65 | 35 | 0 | 0 |
| Resupinates and Polypores, Rare (6 species) | 10 | 70 | 10 | 10 | 10 | 70 | 10 | 10 | 5 | 60 | 20 | 15 | 0 | 50 | 25 | 25 | 0 | 50 | 25 | 25 | 0 | 40 | 30 | 30 | 0 | 50 | 25 | 25 |
| **Other** | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bondarzewia mesenterica | 40 | 30 | 30 | 0 | 40 | 30 | 30 | 0 | 35 | 28 | 33 | 5 | 30 | 25 | 30 | 15 | 30 | 20 | 30 | 20 | 25 | 25 | 35 | 15 | 30 | 25 | 30 | 15 |
| Club Coral Fungi (unknown # of species) | 85 | 10 | 5 | 0 | 80 | 15 | 5 | 0 | 65 | 23 | 13 | 0 | 55 | 30 | 10 | 5 | 50 | 30 | 15 | 5 | 50 | 25 | 20 | 5 | 55 | 25 | 15 | 5 |
| Moss Dwelling Mushrooms (7 species) | 55 | 35 | 10 | 0 | 50 | 35 | 15 | 0 | 45 | 35 | 20 | 0 | 40 | 35 | 25 | 0 | 35 | 40 | 25 | 0 | 35 | 40 | 25 | 0 | 40 | 35 | 25 | 0 |
| Mushroom Lichen | 95 | 5 | 0 | 0 | 95 | 5 | 0 | 0 | 90 | 10 | 0 | 0 | 80 | 20 | 0 | 0 | 75 | 25 | 0 | 0 | 75 | 25 | 0 | 0 | 80 | 20 | 0 | 0 |

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

**Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.**

suitable habitat conditions become available in adjacent stands. Alternatives that retain more of these habitat features generally had higher ratings for species. Alternatives 1, 3, 4, and 9, would be generally the most favorable to bryophytes, because they provide the set of allocations and management practices that best produces the habitat components for bryophytes. Alternative 5 would provide somewhat lesser levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for bryophytes. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

### Effects Common to All Alternatives.

Of the species subject to additional analysis, 115 species did not display a substantially different rating among alternatives, and no additional mitigation was considered adequate to avoid all risk of extirpation from federal lands for these species. These species are restricted to refugia and are known from only one or a few locations. Protection of known populations and surveys for additional sites will decrease the risk of extirpation for these species. Their narrow distribution may be due to either inherent life history characteristics or specific habitat requirements that are sporadic or rare in the landscape. These include 15 species of rare coral fungi, 3 rare boletes, 1 uncommon false truffle, 19 rare false truffles, 25 undescribed rare and false truffles, 3 rare truffles, 14 Phaeocollybia, 7 rare gilled mushrooms, 2 rare ecto-polypores, 2 rare zygomycetes, 6 rare gilled mushrooms, *Oxyporous nobilissimus*, *Bondarzauria montana*, 7 rare resupinates and polypores, 1 uncommon cup fungus, and 8 rare cup fungi (see the Cumulative Effects Including the Role of Nonfederal Lands discussion below). The discussion and analysis for these species is in Appendix J.

Fourteen species would be of concern under all alternatives because of the large percentage of their ranges on nonfederal land. These include four species of rare false truffles, two undescribed rare and false truffles, two rare truffles, one rare zygomycetes, one parasitic fungus, and four rare cup fungi (see discussion of Cumulative Effects Including the Role of Nonfederal Land). These species do not display a substantially different rating among alternatives, and no additional mitigation was considered adequate to fully provide for these species.

### Comparison of Alternatives.

Outcomes for the remaining 383 fungus species are displayed in Table 3&4-23. Alternative 9 would provide 74 percent or greater likelihood of providing habitat, for these species, of sufficient quality, distribution, and abundance to support stable populations either well distributed when measured against their historic range or distributed with gaps in their historical distribution on federal land. Alternatives 1, 3, and 4 would have 66, 62 and 62 percent or greater likelihoods, respectively, of achieving the same outcome(s). Alternative 5 would have a 50 percent or greater likelihood of providing habitat to allow these fungus species to achieve these outcome(s). Alternatives 7 and 8 would each have 40 percent or greater likelihood of providing habitat at that level. The projected future likelihoods of habitat for fungi corresponded with the acreage of Late-Successional Reserves and management in the matrix. Ratings for the groups of fungi were based on habitat conditions on federal lands and varied considerably across the alternatives. Fungi were rated lower for alternatives that had less acreage in Late-Successional Reserves, fewer old-growth patches, and less coarse woody debris and green-tree retention in the matrix. The majority of species evaluated occur on upland sites, so riparian protection may not be as important for many of these fungi as for other organisms. However, fungi associated with riparian areas are not well represented in this evaluation.

The results discussed above for Alternative 9 include consideration of the standards and guidelines added between the Draft and Final SEIS. The change improved outcomes for 101 species that would have at least an 80 percent likelihood of providing stable populations, either well distributed when measured against their historic ranges or with significant gaps in the historic range (described in Chapter 2 and Appendix B11). The list of species includes 4 boletes, 5 false truffles, 9 chanterelles, 13 uncommon coral fungi, 31 uncommon gilled mushrooms, 5 tooth fungi, 14 uncommon cup fungi, 1 jelly mushroom, 3 branched coral fungi, 1 mushroom lichen, 6 parasitic fungi, 1 cauliflower mushroom, 7 moss-dwelling mushrooms, and 1 coral fungus.

An additional four species would be benefited by the standards and guidelines, but not to the level where they would achieve both 80 percent of Outcomes A and B and have no risk of extirpation. These four species are one bolete species, two uncommon ecto-polypores, and one uncommon gilled mushroom. An additional mitigation that would have benefited these species consists of designating all remaining old-growth forest in Marbled Murrelet Zone 1 as reserve. However, that mitigation would cover many areas that may not be occupied by these species. The survey and manage standards and guidelines are more site-specific measures that may provide the same or greater benefit to these species.

Seven of the species subject to additional analysis (all of the club coral fungi) are so poorly known that the level of benefit provided by the mitigation measures is difficult to determine. Surveys for these species should provide additional information that can be used in their conservation.

As noted previously, 15 of the species subject to additional analysis were removed from the list of species being rated, and 115 species remained with outcomes that were not different across alternatives.

### POSSIBLE MITIGATION MEASURES

All of the alternatives contain standards and guidelines that are expected to benefit fungi. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure. Those standards and guidelines which would retain dead, down wood; standing dead trees; stands of live, old-growth trees; and a well-distributed network of late-successional forests would be of greatest benefit to these species. The protection of known locations of the rare and locally endemic fungus species is also important.

The following possible mitigation measures are not represented in the alternatives, but could benefit fungi:

Designate Special Interest Areas or Areas of Critical Environmental Concern.

Identify additional stands for development into old-growth forest in areas where late-successional or old-growth stands are limited.

Within the matrix, maintain a mosaic of forest, age-class distributions, successional stages, habitat structures, habitat types, and topographic positions (i.e., riparian, midslope, and ridgetop). Patches should be large enough (5 to 10 acres at a minimum) to provide for habitat needs, lessen the risk of windthrow, and provide suitable microclimate conditions.

Determine appropriate levels of sustained harvest for commercial species of fungi by inventorying species, collecting baseline data, and monitoring the effects of harvest. Monitoring programs suggested by Molina et al. (1993) could form the basis for determining the effects of harvest, predicting yields, and developing management practices to maintain and enhance wild mushroom harvest.

### CUMULATIVE EFFECTS INCLUDING THE ROLE OF NONFEDERAL LANDS

Fourteen species of fungi representing six of the original groups assessed by the Assessment Team (rare false truffles, rare truffles, undescribed taxa of rare truffles and rare false truffles, rare zygomycetes, rare cup fungi, and parasitic fungi) were reassessed, in part, because they failed to pass the cumulative effects screen. Additional mitigations could not resolve these risks under any of the alternatives (see Appendix J for a complete list of species). Cumulative effects are a concern, although somewhat less critical, for many of the other species considered in this analysis. Important factors contributing to cumulative effects include land ownership patterns and management practices that result in loss of extensive areas of habitat for fungi associated with late-successional forest. For example, four species of rare cup fungi in the genus *Helvella* are known only to occur on nonfederal lands. For many of these species, particular areas of concern are the coastal and low-elevation forests where nonfederal lands play a key role in maintaining species connectivity, and where the amount of late-successional forest is limited due to past harvest. Frequency and intensity of land-disturbing activities on nonfederal lands, including recreation, is another important factor in cumulative effects analysis. Site treatments, which disrupt the soil and litter layer, will have a detrimental effect on populations of fungi, and may alter the role of decaying wood in the nutrient-cycling process. Trampling, compacting the soil and litter layer, removing woody debris for firewood or other reasons, or inadvertently introducing nonnative species could impact fungal populations, particularly the rare species. Forest management practices and site treatments in early-successional stands could also influence the occurrence and diversity of species in late-successional forests. Many species of fungi depend on a renewable supply of large down logs in a managed landscape, and the quality and quantity of this substrate may decline with short-rotation forestry. As an area progresses through several short-rotations, the input of large down logs ceases; trees do not have sufficient time to attain large diameters under the prescribed rotation lengths, except on highly productive sites. Coarse woody debris functions as a nutrient sink that contributes to long-term forest productivity and provides habitat for a wide range of organisms that require this substrate.

Commercial harvest of fungi has greatly increased in recent years, creating potential impacts on species populations and habitats. Harvest of fungi may affect species' viability under any of the alternatives by potentially decreasing distribution, frequency, reproduction, and productivity, as well as genetic variability of species. Currently, most of the species that are commercially harvested are not considered at risk, but future impacts may affect their viability.

Deteriorating air quality may result in a decrease in species' viability under an of the alternatives. Evidence from European forests shows a decline of both ecto-mycorrhizal fungal diversity and abundance due to air pollution. Although other causal factors in this decline are not well established, intensive forestry management practices and harvest of fungi are also implicated. In addition, fungi seem to be sensitive to subtle changes in temperature. This suggests that global climate warming could reduce distributions of species populations, but the likelihood and extent of such an effect cannot be estimated.

## LICHENS

### Affected Environment

The lichen flora in the Pacific Northwest is diverse and abundant. Lichens are a conspicuous component of old-growth forest ecosystems where they play an important ecological role. The lichen flora of the Pacific Northwest includes many endemic species; therefore, extirpation of these species in the region may for some species equate to the extinction of the species as a whole. Twenty-six species closely associated with old-growth forests are endemic to the Pacific Northwest (FEMAT Report, Table IV-A-2, p. IV-220).

Lichens are primary producers: they accumulate biomass and carbohydrates, and contribute to forest nutrient cycling. Arboreal lichens capture fog and retain moisture within the forest canopy. Many lichens fix atmospheric nitrogen (Denison 1973). Their litterfall provides organic material and increases the soil's moisture-holding capacity. The forage lichens are a major food source for animals such as flying squirrels, red-backed voles, and woodrats (Maser et al. 1985). They are also a food source for deer, elk and mountain goats during the winter (Fox and Smith 1988, Hodgman and Boyer 1985). American Indians used forage lichens for food (Turner 1990). Lichens provide habitat and food for canopy-dwelling invertebrates (Gersun and Seaward 1977), and are used by birds and small mammals for nest-building material and camouflage (Broad 1989). Air quality can be assessed by using lichens as biological indicators. Lichens are sensitive to sulfur dioxide and other gases and are efficient accumulators of heavy metals (McCune 1988). Some species of lichens show potential for antibiotic and medicinal qualities (Hawksworth and Hill 1984).

Many lichens have poor dispersal capability and are not able to move far from the parent plant. Small patches of old-growth forest fragments distributed across the landscape are important as refugia and centers of dispersal (Esseen et al. 1992). Some lichens, particularly the nitrogen-fixing species, do not become established until stands are several hundred years old (McCune, in press). Older stands that are well distributed geographically are believed to be important to the survival and persistence of these species in the ecosystem. Riparian protection on all orders of streams are important for the riparian and aquatic lichens.

Habitat components important to lichens primarily include the availability of live, old-growth trees, but decaying wood and riparian zones are also important to some species. Live trees provide substrates for most lichen species although others grow on decaying wood as well as on rocks, in soil, or in streams. Aquatic lichens are found on rocks in streams and create conditions that enhance aquatic invertebrate populations.

## Environmental Consequences

### METHODS SPECIFIC TO LICHENS

The assessment panel evaluated the outcome of 157 species of lichens that are closely associated with late-successional and old-growth forests. This is a fairly comprehensive list of the macrolichens that occur in old-growth forests in the Pacific Northwest. Seven species were not assessed because of uncertainty about their biology or distribution (FEMAT Report, Table IV-A-2, p. 220). Since little is known about the distribution and habitat requirements of these species, there is uncertainty about the effects of forest management activities on habitats supporting these species. Generally the alternatives that manage for more extensive and interconnected late-successional and old-growth forest conditions will minimize the risks to these species. The relative lack of information concerning these species serves as an impetus to the monitoring and research and adaptive management plans that are part of these alternatives. Should habitat conditions decline significantly from projections, or should additional scientific information indicating a decline of these species become available, management of the relevant area would be considered for change under the adaptive management process described in this Final SEIS, Chapter 2, in the Implementation Section.

Lichen species were divided into 12 functional groups based on ecological relationships, and some of these were further subdivided by their degree of rarity. A discussion of the various groups is presented in the FEMAT Report. The Assessment Team concluded that rare species that exist in refugia historically or naturally could not rate higher than Outcome C because these species will always be distributed in isolated pockets or refugia regardless of the alternative.

All 16 groups of lichens, representing 136 species, were subject to additional analysis related to their ratings in the FEMAT Report. However, 5 groups representing 57 species had only a very low likelihood of risk of extirpation. Groups and species that were assessed as having less than 3 percent likelihood of risk of extirpation were not evaluated further if the total likelihood of Outcomes C and D was less than 20 percent.

To better reflect the specific information available, species were considered separately in the additional analysis (see Appendix J), rather than in the groups as in the FEMAT Report (See Table 3&4-24). Seventy-five species of lichens did not meet the above modified criterion and were subject to additional analysis. No additional species were analyzed solely on the basis of cumulative effects. However, cumulative effects in the form of air pollution or collection of lichens as special forest products will certainly influence many of the species that were analyzed (see discussion below on Cumulative Effects Including the Role of Nonfederal Land).

## EFFECTS OF ALTERNATIVES

Results for lichen species, for all alternatives, are shown in Table 3&4-24. The species or species' ranges shown in the shaded portion of Table 3&4-24 are those that were specifically considered when additional standards and guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the added standards and guidelines. The ratings shown in Table 3&4-24 have not been changed to reflect these additions to the alternative. The additional standards and guidelines for lichens that have been incorporated in Alternative 9 are described in detail in Chapter 2 and Appendix B11 of this SEIS.

The habitat components important to lichens include live, old-growth trees, decaying wood, riparian zones, and extensive and interconnected late-successional and old-growth forest conditions. Alternatives 1, 4, and 9, would generally be the most favorable to lichens, because they provide the set of allocations and management practices that best produces the habitat components for lichens. Alternatives 3 and 5 would provide somewhat lower levels of this habitat. Alternatives 7 and 8 are similar in their effects, and would provide less favorable habitat conditions for lichens. Based on their overall features, Alternative 2 would likely have effects between those of Alternatives 3 and 5, Alternative 6 would likely have effects similar to Alternative 5, and Alternative 10 would likely have effects between those of Alternatives 5 and 7.

The analysis indicated significant likelihoods of restriction to refugia or some risk of extirpation under any of the alternatives considered in the SEIS for the oceanic-influenced lichens, rare oceanic-influenced lichens, rare rock lichens, the rare forage lichen, the two rare leafy arboreal lichens, and the six rare nitrogen-fixing lichens. No mitigations could be defined for these groups that would significantly improve the existing ratings. As mentioned above, the Assessment Team concluded that rare species that exist in refugia historically or naturally could not rate higher than Outcome C because these species will always be distributed in isolated pockets or refugia regardless of the alternative. See the discussion of these groups in the Cumulative Effects Including the Role of Nonfederal Lands section below.

For the remaining 10 common and rare lichen groups, Alternatives 1, 4, and 9 generally rated higher than other alternatives (Table 3&4-24). Alternatives 1, 4, and 9 (with additional standards and guidelines) would have 79, 78 and 73 percent or greater likelihoods, respectively, of providing habitat of sufficient quality, distribution, and abundance to allow the remaining 10 common and rare lichen group populations to stabilize either well distributed when measured against historic distribution or distributed with gaps in the historic

## Table 3&4-24. Projected future likelihood for lichens habitat outcomes under land management alternatives in the Draft SEIS

| | Alternative 1 | | | | Alternative 3 | | | | Alternative 4 | | | | Alternative 5 | | | | Alternative 7 | | | | Alternative 8 | | | | Alternative 9 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Lichens** | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D | A | B | C | D |
| Aquatic (3 species) | 30 | 53 | 16 | 1 | 13 | 53 | 31 | 3 | 24 | 55 | 19 | 2 | 10 | 45 | 29 | 16 | 2 | 20 | 53 | 25 | 0 | 22 | 52 | 26 | 10 | 47 | 27 | 16 |
| Decaying wood ( 8 species) | 78 | 18 | 3 | 1 | 65 | 29 | 5 | 1 | 62 | 30 | 7 | 1 | 40 | 41 | 14 | 5 | 22 | 50 | 21 | 7 | 11 | 47 | 37 | 5 | 40 | 42 | 17 | 1 |
| Forage Lichen (10 species) | 80 | 18 | 1 | 1 | 70 | 27 | 2 | 1 | 58 | 39 | 2 | 1 | 47 | 41 | 9 | 3 | 28 | 49 | 19 | 4 | 34 | 47 | 17 | 2 | 61 | 32 | 5 | 2 |
| Forage Lichen, Rare (1 species) | 0 | 20 | 68 | 13 | 3 | 35 | 49 | 14 | 0 | 10 | 74 | 16 | 0 | 6 | 69 | 25 | 0 | 4 | 53 | 44 | 0 | 8 | 58 | 35 | 0 | 6 | 75 | 19 |
| Leafy Arboreal ( 17 species) | 89 | 9 | 1 | 1 | 81 | 17 | 1 | 1 | 76 | 19 | 4 | 1 | 59 | 33 | 7 | 1 | 37 | 45 | 17 | 1 | 36 | 45 | 18 | 1 | 52 | 40 | 7 | 1 |
| Leafy Arboreal, Rare ( 2 species) | 4 | 26 | 67 | 3 | 1 | 25 | 70 | 4 | 1 | 20 | 72 | 7 | 1 | 18 | 72 | 9 | 0 | 15 | 69 | 16 | 1 | 15 | 69 | 15 | 0 | 20 | 63 | 17 |
| Nitrogen-fixing Lichens ( 20 species) | 55 | 41 | 3 | 1 | 45 | 45 | 7 | 3 | 41 | 50 | 6 | 3 | 9 | 60 | 27 | 4 | 3 | 44 | 41 | 12 | 8 | 35 | 51 | 6 | 17 | 56 | 23 | 4 |
| Nitrogen-fixing Lichens, Rare ( 6 species) | 4 | 34 | 56 | 6 | 0 | 32 | 57 | 11 | 0 | 26 | 58 | 16 | 0 | 12 | 60 | 28 | 0 | 8 | 54 | 38 | 0 | 10 | 50 | 40 | 0 | 20 | 52 | 28 |
| Oceanic Influence (4 species) | 8 | 45 | 44 | 4 | 5 | 45 | 46 | 4 | 5 | 43 | 46 | 6 | 5 | 38 | 49 | 9 | 0 | 23 | 63 | 15 | 0 | 23 | 63 | 15 | 5 | 40 | 46 | 9 |
| Oceanic Influence, Rare (12 species) | 0 | 16 | 60 | 24 | 0 | 12 | 67 | 21 | 0 | 8 | 65 | 27 | 0 | 8 | 60 | 32 | 0 | 2 | 52 | 46 | 0 | 0 | 54 | 46 | 0 | 12 | 59 | 29 |
| Pin Lichens (16 species) | 37 | 47 | 15 | 1 | 30 | 48 | 21 | 1 | 30 | 48 | 21 | 1 | 23 | 47 | 27 | 3 | 11 | 38 | 42 | 9 | 10 | 30 | 51 | 9 | 22 | 46 | 29 | 3 |
| Riparian ( 9 species) | 18 | 61 | 18 | 3 | 11 | 53 | 33 | 3 | 16 | 62 | 19 | 3 | 6 | 52 | 36 | 6 | 2 | 36 | 48 | 14 | 4 | 26 | 50 | 20 | 9 | 54 | 32 | 5 |
| Rock ( 4 species) | 57 | 37 | 5 | 1 | 42 | 51 | 6 | 1 | 39 | 52 | 7 | 2 | 32 | 51 | 14 | 3 | 22 | 53 | 22 | 3 | 22 | 51 | 22 | 5 | 31 | 52 | 16 | 1 |
| Rock, Rare (2 species) | 3 | 15 | 65 | 18 | 0 | 15 | 60 | 25 | 0 | 13 | 64 | 24 | 0 | 13 | 59 | 29 | 0 | 10 | 45 | 45 | 0 | 8 | 49 | 44 | 3 | 13 | 56 | 29 |
| Soil ( 8 species) | 78 | 18 | 3 | 1 | 72 | 23 | 4 | 1 | 70 | 23 | 6 | 1 | 64 | 29 | 6 | 1 | 58 | 31 | 10 | 1 | 62 | 31 | 6 | 1 | 70 | 23 | 6 | 1 |
| Tree boles (14 species) | 76 | 21 | 2 | 1 | 69 | 26 | 4 | 1 | 60 | 33 | 4 | 3 | 55 | 36 | 6 | 3 | 26 | 57 | 13 | 4 | 26 | 60 | 11 | 3 | 46 | 44 | 7 | 3 |

A-Well Distributed B-Locally Restricted C-Restricted to Refugia D-Risk of Extirpation

**Likelihood values are expressed as percentages that total to 100 for a given species within an Alternative. Number displayed may vary due to rounding errors. The Species shown in the shaded portion of the table are those that were specifically considered when additional standards are guidelines were added to Alternative 9. However, ratings for all species under Alternative 9 might be increased by the standards and guidelines. The ratings shown in the table have not been changed to reflect these additions to Alternative 9. See text for fuller explanation and discussion of the rating scale and for discussion of the additional species analysis under Alternative 9.**

species' distributions across federal lands. Alternatives 3 and 5 would have 64 and 55 percent or greater likelihoods, respectively, of providing habitat to allow the remaining 10 common and rare lichen group populations to achieve the same outcome(s). Alternatives 7 and 8 would each have 22 percent or greater likelihood of providing habitat at those levels for the remaining 10 common and rare lichen groups. Outcome ratings for lichens were generally correlated with the acreage of Late-Successional Reserves, stand treatments within the matrix, and protection for riparian corridors (aquatic and riparian lichens). Rare lichens rated much lower than common lichens because some of the rare lichen species have narrow geographic ranges and only occur in special habitats. Many of these special habitats occur as rare combinations of abiotic and biotic conditions such as a specific tree species in the fog zone of a waterfall at a low elevation.

### POSSIBLE MITIGATION MEASURES

All of the alternatives contain standards and guidelines that are expected to benefit lichens. As noted in the section earlier, to avoid or reduce impacts, a standard or guideline in one alternative could be added to another that currently does not include the measure . Those standards and guidelines which would increase the availability of live, old-growth trees and decaying wood, and riparian zones would be of greatest benefit to these species.

The following possible mitigation measures are not represented in the alternatives, but could benefit lichens:

Designate Botanical Special Interest Areas (BSIA) or Areas of Critical Environmental Concern (ACEC).

Management plans have been developed by federal agencies for many rare animals and vascular plants; similar plans could be developed to address rare lichen species. Such plans provide biological and habitat information, management direction, and recommendations for selecting and monitoring key populations.

Retention of trees on ridgelines would benefit some lichen species because this location optimizes dispersal. This pattern of retaining trees mimics the retention patterns created by natural fire.

### CUMULATIVE EFFECTS INCLUDING THE ROLE OF NONFEDERAL LANDS

Nearly all of the species of lichens (with the possible exception of the pin lichens) are sensitive to air pollution. Increased levels of particulate matter and other pollutants may pose a risk to long-term survival of these species under any of the alternatives. The rare nitrogen-fixing lichens have a narrow ecological tolerance, generally inhabiting stands that are over 200 years old. Several of the species in this group are also most strongly associated with low elevation forests that are largely on nonfederal lands. These factors led to cumulative effects concerns under all of the alternatives. Nonfederal land management is important to the long-term viability of rare rock lichens because road building and rock quarry operations have reduced habitat for these species. The aquatic lichens are sensitive to acid precipitation, and are often taken incidentally by moss collectors in accessible areas of their range. In addition, recreational activity and destruction of habitat in populated coastal areas cause cumulative effects risks to viability of the rare oceanic-influenced lichens.

Much of the low elevation forest land in the Pacific Northwest is in nonfederal ownership (and administered by state and private timber managers). This land covers thousands of acres and is generally managed on short harvest rotations. Given that lichens are slow to establish in rapidly growing stands and that many species do not become abundant until later in the successional development, most of these stands are harvested before lichens have a chance to establish substantial populations. Lichens considered in this assessment have poor dispersal capability, and restoration of populations on managed nonfederal lands cannot be assured under any of the alternatives.

# Vascular Plants

## AFFECTED ENVIRONMENT

The largest and most dominant organisms of the late-successional and old-growth forest ecosystem are the vascular plants, some of which may tower over 250 feet and have lifespans over 1,000 years. Vascular plants are defined as those that contain conducting or vascular tissue. They include seed-bearing plants (flowering plants and conifers) and spore-bearing forms, such as ferns. They create the structure of the forest and function as the primary producers, capturing sunlight through photosynthesis and converting it to food consumed by animals and fungi. Vascular plants provide substrate and habitat for other organisms, influence microclimate (e.g., sunlight, humidity, and temperature), and provide forage, hiding, and thermal cover for vertebrate and invertebrate species. They produce litterfall that contributes to organic matter and soil development. Some species are symbiotic with fungi and other vascular plants, while others fix nitrogen. Trees with dwarf mistletoe develop broom-like structures that function as nesting platforms for birds and small mammals. Many vascular plants have close relationships with specific animal pollinators and predators.

In addition to their vital role in maintaining a functioning ecosystem, vascular plants provide commercial resources, including timber, forage, and other forest products. Harvest of medicinal, horticultural, and edible plants from Pacific Northwest forests has increased dramatically in recent years. Commercially-collected vascular plant species include beargrass, salal, huckleberry, sword fern, cascara, and Pacific yew.

Within the range of the northern spotted owl, several important areas of high diversity are recognized that feature plants that are restricted to narrow geographical areas. The areas with the greatest number of endemic species include the Oregon and California Klamath Provinces, the Olympic Peninsula Province, the Columbia River Gorge, and the Wenatchee Mountains. Rare and local plants are often restricted to distinctive soils (e.g., serpentine or ultramafic) and to special habitats such as rock outcrops, bogs, and wetlands.

Nonphotosynthetic species, such as fringed pinesap and coralroot orchid, are characterized by complex, symbiotic relationships involving both fungi and photosynthetic vascular plants (Furman and Trappe 1971, Wells 1981).

While many vascular plants colonize quickly and have short reproductive cycles, most species closely associated with late-successional and old-growth

United States
Department of
Agriculture

Forest Service

United States
Department of
the Interior

Bureau of Land
Management

February 1994

# Final Supplemental Environmental Impact Statement

## on Management of Habitat for Late-Successional and Old-Growth Forest Related Species Within the Range of the Northern Spotted Owl

## Volume II - Appendices

# Appendix B11
# Standards and Guidelines Resulting From Additional Species Analysis and Changes to Alternative 9

The following standards and guidelines were developed in response to public and internal comments to increase protection of habitat for species whose habitat assessments were relatively low under Alternative They are incorporated in Alternative 9 as standards and guidelines in this Final SEIS.

## Survey and Manage

The "survey and manage" standard and guideline would provide benefits to amphibians, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods. The standard and guideline contains four components, and priorities differ among them:

### 1. MANAGE KNOWN SITES

Management of known species sites should receive the highest priority. Efforts must be undertaken to ac information on these known sites and to manage this information so that it is available to all project planr An effective way to accomplish this is to compile the information in a Geographic Information System (GI data base. Those efforts should be coordinated by the Regional Ecosystem Office, and should be complet expeditiously. As soon as the information becomes available, it should be used in the design or modificat activities. Activities that are implemented in 1994 should use this information to the greatest degree possi Activities implemented in 1995 and later must include provisions for these known sites. In most cases, th appropriate action will be protection of relatively small sites, on the order of tens of acres. For some speci including some vascular plants, the appropriate action will include the use of specific management treatm such as prescribed fire. For rare and endemic fungus species, areas of 160 acres should be temporarily withdrawn from ground-disturbing activities around known sites until those sites can be thoroughly sur and site-specific measures prescribed. For one fungus species, *Oxyporous nobilissimus*, there are only six kn sites and two of these do not currently have a protected status. Management areas of 600 acres are to be established around these two sites for the protection of those populations. The actions to protect *Oxyporo* must be undertaken immediately.

### 2. SURVEY PRIOR TO GROUND-DISTURBING ACTIVITIES

Measures to survey for species and manage newly discovered sites are to be phased-in over a somewhat lo timeframe than the measures to protect currently known sites. For some species, these efforts have been ongoing through rare and sensitive species programs. Where such efforts have been ongoing, they shoul continue. However, protocols have not been developed for surveys for all of these species, and the experti needed to conduct them is not readily available in some cases. Efforts to design protocols and implement surveys should be started immediately. Where surveys are completed, the information gathered from the should be used to establish managed sites for species. Surveys must precede the design of all ground-disturbing activities that will be implemented in 1997 or later, and management standards and guidelines be developed to manage habitat for the species on sites where they are located. These surveys may be conducted at a scale most appropriate to the species. For most species, this survey would start at the wa analysis level with identification of likely species' locations based on habitat. Those likely locations wo be thoroughly searched prior to implementation of activities. For other species, the identification of like may be most appropriately done at the scale of individual projects. Surveys should be designed for maxi efficiency, focusing on the likely range and habitats of the target species. Multispecies surveys should be used wherever they would be most efficient. To the degree possible, surveys should be designed to minimize the number of site visits needed to acquire credible information. Survey protocols and proposed site management should be incorporated into interagency conservation strategies developed as part of ongoing planning efforts coordinated by the Regional Ecosystem Office.

### 3. EXTENSIVE SURVEYS

Conduct extensive surveys for the species to find high priority sites for species management. Specific surveys prior to ground-disturbing activities are not a requirement. Rather, the surveys will be done according to a schedule that is most efficient, and sites will be identified for protection at that time. This strategy entails some risk because some species sites may be disturbed prior to completion of surveys. It is recommended primarily for species whose characteristics make site and time-specific surveys difficult. For example, some fungi only produce fruiting bodies under specific climatic conditions, therefore, finding their location may take several to many years. It would be most efficient to do broad surveys for these species during times of appropriate conditions rather than attempting annual, site-specific surveys. Surveys under this strategy must be underway by 1996. As with surveys described in item 2 above, surveys should be designed for efficiency and standardized protocols should be developed.

### 4. GENERAL REGIONAL SURVEYS

The objective is to survey for the species to acquire additional information and to determine necessary levels of protection. Species intended to benefit from this standard and guideline are the arthropods, the fungi species that were not classed as rare and endemic, bryophytes, and lichens. These groups of species are particularly poorly known. Many species have likely not yet been identified, and there is only general information available on the abundance and distribution of known species. The information gathered through these efforts may be useful in refining the selected alternative as part of the adaptive management process to better provide for these species. These surveys are expected to be both extensive and expensive, but the information from them is critical to successful implementation of ecosystem management. They should be completed within 10 years.

Table B11-1 shows species covered by the survey and manage provision, and which of the four strategies above is to be applied to each. These measures may apply within any land allocations. However, the survey and manage provision for each species will be directed to the range of that species and the particular habitats that it is known to occupy.

## Riparian Reserves

Riparian Reserve Scenario 1 will be applied on intermittent streams throughout the range of the northern spotted owl. This is a change from the Draft SEIS that specified Riparian Reserve Scenario 2 outside of Tier 1 Key Watersheds. Scenario 1 is described in Appendix B6, Aquatic Conservation Strategy, and in Chapter 2 of this Final SEIS. As noted in Chapter 2, the prescribed Riparian Reserve widths for intermittent streams may be adjusted in decisions following watershed analysis. That analysis should take into account all species that were intended to be benefited by this standard and guideline. Those species include fish, mollusks, amphibians, lichens, fungi, bryophytes, vascular plants, American marten, red tree voles, bats, marbled murrelets, and northern spotted owls. The specific issue for spotted owls is retention of adequate habitat conditions for dispersal.

The second standard and guideline for riparian species is to ensure that riparian management in Adaptive Management Areas provides species protection equivalent to Riparian Reserves. In most cases, riparian protection in Adaptive Management Areas should be comparable to that prescribed for other federal land allocations. However, in those cases where alternate means are proposed to meet riparian objectives, those alternate means must meet objectives for management of all species. In areas where there are concerns about species as noted above, species protection takes priority over any objectives that would reduce reserves, and adjustments to Riparian Reserves should take into account all species that were intended to be benefited by this standard and guideline.

## Matrix Management Standards and Guidelines

A variety of provisions for forest management in the matrix will be implemented. These measures build on the standards and guidelines originally presented in the Draft SEIS. The measures include standards and guidelines for coarse woody debris, revised standards and guidelines for green-tree and snag retention, modification of site treatment practices, provisions to protect cave entrances, and measures that provide additional protection of late-successional forests in watersheds where they are currently scarce. These measures are described as follows.

### PROVIDE SPECIFIED AMOUNTS OF COARSE WOODY DEBRIS IN MATRIX MANAGEMENT

A renewable supply of large down logs is critical for maintaining populations of fungi, arthropods, bryophytes and various other organisms that use this habitat structure. Provision of coarse woody debris is also a key standard and guideline for American marten, fisher, two amphibians, and two species of vascular plants. The objective is to provide coarse woody debris well distributed across the landscape in a manner that meets the needs of species and provides for ecological functions. Standards and guidelines should provide for appropriate coarse woody debris quantity, quality (such as species, decay stage and size) and distribution. Models for computing expected numbers and sizes of logs should be developed for groups of plant associations and stand types which can be used as a baseline for managers to develop prescriptions for landscape management. An important factor is to provide the coarse woody debris within a forest patch so that the appropriate microclimate for various organisms that use this substrate is available. Coarse woody debris that is already on the ground needs to be retained and protected from disturbance to the greatest extent possible during logging and other land management activities that might destroy the integrity of the substrate. As the stand regenerates, scattered green trees will provide a future supply of coarse woody debris and will be important in providing for the distribution of this substrate throughout the managed landscape.

### Specific Standards and Guidelines for Coarse Woody Debris

These measures are intended to be applied in matrix forests. The intent of the measures must also be met in Adaptive Management Areas, but specific standards and guidelines are not prescribed for those areas.

A. Manage to provide a renewable supply of large down logs well distributed across the matrix landscape in a manner that meets the needs of species and provides for ecological functions. Develop models for groups of plant associations and stand types that can be used as a baseline for developing prescriptions.

B. The following interim guidelines apply in areas of regeneration harvests: for northern California National Forests, use the Draft Forest Plan standards and guidelines for down logs; for western Oregon and Washington north of and including the Willamette National Forest, leave 240 linear feet of logs per acre greater than or equal to 20 inches in diameter. Logs less than 20 feet in length cannot be credited toward this total. In eastern Oregon and Washington, and western Oregon south of the Willamette National Forest and the Eugene BLM District, a minimum of 120 linear feet of logs per acre greater than or equal to 16 inches in diameter and 16 feet long should be retained. Decay class 1 and 2 logs can be counted towards these totals. Down logs should reflect the species mix of the original stand. In all cases, standards and guidelines from current plans and draft plan preferred alternatives apply if they provide greater amounts. In areas of partial harvest, the same basic guidelines should be applied, but they should be modified to reflect the timing of stand development cycles where partial harvesting is practiced.

C. Coarse woody debris already on the ground should be retained and protected to the greatest extent possible from disturbance during treatment (e.g., slash burning and yarding) which might otherwise destroy the integrity of the substrate.

D. Down logs should be left within forest patches that are retained under green tree retention standards and guidelines in order to provide the microclimate that is appropriate for various organisms that use this substrate.

E. As with all standards and guidelines, these are meant to provide initial guidance, but further refinement will be required for specific geographic areas. This can be accomplished through planning based on watershed analysis, and the adaptive management process.

### EMPHASIZE CLUMPED GREEN-TREE AND SNAG RETENTION IN MATRIX MANAGEMENT

For many species, benefits will be greatest if trees are retained in patches rather than singly. Because very small patches do not provide suitable microclimates for many of these organisms, patches should generally be larger than 1 hectare (about 2.5 acres, unit size permitting).

Although many species would benefit from retention of patches, others may be favored by retention of single trees. Ultimately, the relative proportion of patches versus single trees retained must reflect local knowledge of individual species' needs.

Retained patches should be protected for multiple rotations to provide support for those organisms that require very old forests.

### Specific Standards and Guidelines for Green-Tree and Snag Retention

These measures are intended to be applied throughout the matrix forests. Their intent should be met in Adaptive Management Areas, but standards and guidelines are not prescribed for those areas.

A. For lands administered by the BLM in Oregon, follow standards and guidelines described in Chapter 2 and Appendix B9.

B. For all other lands, retain at least 15 percent of the area of each cutting unit except within the Oregon Coast Range and Olympic Peninsula Provinces. On the Mt. Baker-Snoqualmie National Forest, this retention guideline does not apply, but site-specific prescriptions should be developed to maintain biological diversity and ecosystem function, including retention of green trees (singly and in patches), snags and down logs. Exceptions are made for the Oregon Coast Range and Olympic Peninsula Provinces because substantial retention is provided by marbled murrelet and riparian protection measures. If, as a result of watershed analysis or any future delisting of the murrelet, protection is reduced significantly, green-tree retention standards and guidelines may be required in these provinces.

B. Of the total area to be retained, at least 70 percent should be in patches greater than 1 hectare (unit size permitting), with the remainder as single trees or smaller patches dispersed across the cutting unit. To the extent possible, patches should include the largest, oldest live trees, decadent or leaning trees, and hard snags occurring in the unit. Patches should be retained indefinitely.

C. As a minimum, snags are to be retained within the harvest unit at levels sufficient to support species of cavity-nesting birds at 40 percent of potential population levels based on published guidelines and models. The objective is to meet the 40 percent minimum standard throughout the matrix, with per-acre requirements met on average areas no larger than 40 acres. To the extent possible, snag management within harvest units should occur within the areas of green-tree retention. The needs of bats should also be considered in these standards and guidelines as those needs become better known.

D. As with all standards and guidelines, these are meant to provide initial guidance, but further refinement will be required for specific geographic areas. This can be accomplished through planning based on watershed analysis, and the adaptive management process which includes significant oversight review.

## PROVIDE ADDITIONAL PROTECTION FOR CAVES, MINES, AND ABANDONED WOODEN BRIDGES AND BUILDINGS THAT ARE USED AS ROOST SITES FOR BATS

Most bat species occurring in the Pacific Northwest roost and hibernate in crevices in protected sites. Suitable roost sites and hibernacula, however, fall within a narrow range of temperature and moisture conditions. Sites commonly used by bats include caves, mines, snags and decadent trees, wooden bridges, and old buildings. Additional provisions for the retention of large snags and decadent trees are included in the standard and guideline for green-tree patches in the matrix. Caves, mines, and abandoned wooden bridges and buildings, however, are extremely important roost and hibernation sites, and require additional protection to ensure their value as habitat is maintained.

This provision is intended to apply in matrix forests and Adaptive Management Areas. Conduct surveys of crevices in caves, mines, and abandoned wooden bridges and buildings for the presence of roosting bats, including fringed myotis, silver-haired bats, long-eared myotis, long-legged myotis, and pallid bats. For the purposes of this standard and guideline, caves are defined as in the Federal Cave Resources Protection Act of 1988 as "any naturally occurring void, cavity, recess, or system of interconnected passages which occur beneath the surface of the earth or within a cliff or ledge (. . . but not including any. . . man-made excavation) and which is large enough to permit an individual to enter, whether or not the entrance is naturally formed or man-made." Searches should be conducted during the day in the summer (to locate day roosts and maternity colonies), at night during the late summer and fall (to locate night roosts, which are important for reproduction), and during the day in the winter (to locate hibernacula). If bats are found, identify the species using the site and determine for what purpose it is being used by bats. As an interim measure, timber harvest is prohibited within 250 feet of sites containing bats. Management standards and guidelines, which may be included as mitigation measures in project or activity plans, will be developed for the site. These standards and guidelines will be developed following an inventory and mapping of resources. The purpose of the standards and guidelines will be protection of the site from destruction, vandalism, disturbance from road construction or blasting, or any other activity that could change cave or mine temperatures or drainage patterns. The size of the buffer, and types of activities allowed within the buffer, may be modified through the standards developed for the specific site. Retention of abandoned bridges or buildings must be made contingent on safety concerns.

Townsend's big-eared bats are of concern to state wildlife agencies in both Washington and Oregon. These bats are strongly associated with caves, and are extremely sensitive to disturbance, especially from recreational cavers. When Townsend's big-eared bats are found occupying caves or mines on federal land, the appropriate agency should be notified, and management prescriptions for that site should include special consideration for potential impacts on this species.

## MODIFY SITE TREATMENT PRACTICES, PARTICULARLY THE USE OF FIRE AND PESTICIDES, AND MODIFY HARVEST METHODS TO MINIMIZE SOIL AND LITTER DISTURBANCE

Many species of soil and litter-dwelling organisms, such as fungi and arthropods, are sensitive to soil and litter disturbance. Site treatments should be prescribed that will minimize intensive burning, unless appropriate for certain specific habitats, communities or stand conditions. Prescribed fires should be planned to minimize the consumption of litter and coarse woody debris. Other aspects to this standard and guideline include minimizing soil and litter disturbance that may occur as a result of yarding and operation of heavy equipment, and reducing the intensity and frequency of site treatments. Soil compaction, and removal or disturbance of humus layers and coarse woody debris, may impact populations of fungi and arthropods. These provisions are intended to apply throughout the matrix forests and within the Adaptive Management Areas.

### PROVIDE FOR RETENTION OF OLD-GROWTH FRAGMENTS IN WATERSHEDS WHERE LITTLE REMAINS

The distribution of old-growth stands throughout the landscape is an important component of ecosystem diversity, and plays a significant role in providing for biological and structural diversity across the landscape. Isolated remnant old-growth patches are ecologically significant in functioning as refugia for a host of old-growth associated species, particularly those with limited dispersal capabilities that are not able to migrate across large landscapes of younger stands. These include, but are not limited to, many species of fungi, lichens, bryophytes, arthropods, and vascular plants, and will likely include vertebrate species such as small mammals and amphibians, and various bird species. Isolated patches will function as refugia where old-growth associated species are able to persist until conditions become suitable for their dispersal into adjacent stands. Loss of these old-growth stands may result in local extirpation of an array of species. It is prudent to retain what little remains of this age class within landscape areas where it is currently very limited. This will ensure future options for management and enhancement of the diversity within adjacent developing stands.

Landscape areas where little late-successional forest persists should be managed to retain late-successional patches. This standard and guideline will be applied in fifth field watersheds (20 to 200 square miles) which are currently comprised of 15 percent or less late-successional forest. This assessment should include all allocations in the watershed. Within such an area, all remaining late-successional stands should be protected. Protection of these stands could be modified in the future, when other portions of the watershed have recovered to the point where they could replace the ecological roles of these stands.

In fifth field watersheds that contain more than 25 percent nonfederal land, this provision should be treated as a threshold for analysis rather than a standard and guideline. If less than 15 percent of the total landscape in such watersheds consists of late-successional forest, the role of those stands must be recognized. A proposal to modify such stands should only be implemented following a watershed analysis that considers the ecological function of the remaining late-successional forest and its location in the landscape.

In Adaptive Management Areas, less than 15 percent of fifth field watershed in late-successional forest should also be considered as a threshold for analysis rather than a strict standard, and the role of remaining stands of late-successional forests must be fully considered in watershed analysis before they can be modified.

## Northern Spotted Owl Activity Centers

This standard and guideline institutes a recommendation that was contained in both the Interagency Scientific Committee (ISC) Conservation Strategy for northern spotted owls and the Final Draft Spotted Owl Recovery Plan (USDI unpub.). The standard and guideline applies to spotted owl activity centers that are not protected by Congressionally Reserved Areas, Late-Successional Reserves, Riparian Reserves, Managed Late-Successional Areas, or Administratively Withdrawn Areas. One hundred acres of the best northern spotted owl habitat will be retained as close to the nest site or owl activity center as possible for all spotted owl activity centers known to occur in the matrix and Adaptive Management Areas as of January 1, 1994. This is intended to preserve an intensively used portion of the breeding season home range. "Activity center" is defined as an area of concentrated activity of either a pair of spotted owls or a territorial single owl. Timber management activities within the 100-acre area should comply with management standards and guidelines for Late-Successional Reserves. Management around this area will be designed to reduce risks of natural disturbance. These areas are to be maintained permanently, subject to normal changes through adaptive management.

## Protect Sites From Grazing

This standard and guideline is designed to benefit mollusks, arthropods, and vascular plants. Known and newly-discovered sites of these species will be protected from grazing by all practicable steps to ensure that the local populations of the species will not be impacted. This standard and guideline may apply throughout all land allocations. Species to be protected through this standard and guideline are:

**Arthropods**: Litter and soil-dwelling species (south range)

**Mollusks**: *Ancotrema voyanum, Monadenia fidelis klamathica, Monadenia fidelis ochromphalus, Pristiloma articum crateris, Fluminicola n.* sp. 1, *Fluminicola n.* sp. 11, *Fluminicola n.* sp. 19, *Fluminicola n.* sp. 20, *Fluminicola n.* sp. 3, *Fluminicola seminalis*

**Vascular Plants**: *Pedicularis howellii*

## Manage Recreation Areas to Minimize Disturbance to Species

This standard and guideline will benefit a number of fungi and lichen species whose known locations are predominantly within established recreation sites. This standard and guideline falls within the category of the survey and manage standard and guideline above, and species to be protected through this standard and guideline are among those shown in Table B11-1. This standard and guideline may apply throughout all land allocations. Additional information on the habitat requirements of these species are discussed in Appendix J.

## Other Measures

This category includes additional site-specific standards and guidelines that will be implemented to provide for sites under the survey and manage standard and guideline. Such measures have been identified for some of the mollusk, fungi, and lichen species. This standard and guideline falls within the category of the survey and manage standard and guideline above, and species to be protected through this standard and guideline are among those shown in Table B11-1. It may apply throughout all land allocations. Additional information on the habitat requirements of these species are discussed in Appendix J.

Table B11-1. Species to be protected through survey and management standards and guidelines. Each of the four survey strategies is described in the text.

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Fungi** | | | | |
| **Mycorrhizal Fungi** | | | | |
| **Boletes** | | | | |
| *Gastroboletus subalpinus* | X | | X | |
| *Gastroboletus turbinatus* | | | X | |
| **Boletes, low elevation** | | | | |
| *Boletus piperatus* | | | X | |
| *Tylopilus pseudoscaber* | X | | X | |
| **Rare Boletes** | | | | |
| *Boletus haematinus* | X | | X | |
| *Boletus pulcherrimus* | X | | X | |
| *Gastroboletus imbellus* | X | | X | |
| *Gastroboletus ruber* | X | | X | |
| **False Truffles** | | | | |
| *Nivatogastrium nubigenum* | X | | X | |
| *Rhizopogon abietis* | | | X | |
| *Rhizopogon atroviolaceus* | | | X | |
| *Rhizopogon truncatus* | | | X | |
| *Thaxterogaster pingue* | | | X | |
| **Uncommon False Truffle** | | | | |
| *Macowanites chlorinosmus* | X | | X | |
| **Rare False Truffles** | | | | |
| *Alpova alexsmithii* | X | | X | |
| *Alpova olivaceotinctus* | X | | X | |
| *Arcangeliella crassa* | X | | X | |
| *Arcangeliella lactarioides* | X | | X | |
| *Destuntzia fusca* | X | | X | |
| *Destuntzia rubra* | X | | X | |
| *Gautieria magnicellaris* | X | | X | |
| *Gautieria otthii* | X | | X | |
| *Leucogaster citrinus* | X | | X | |
| *Leucogaster microsporus* | X | | X | |
| *Macowanites lymanensis* | X | | X | |
| *Macowanites mollis* | X | | X | |
| *Martellia fragrans* | X | | X | |
| *Martellia idahoensis* | X | | X | |
| *Martellia monticola* | X | | X | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Rare False Truffles (continued)** | | | | |
| *Octavianina macrospora* | x | | x | |
| *Octavianina papyracea* | x | | x | |
| *Rhizopogon brunneiniger* | x | | x | |
| *Rhizopogon evadens var. subalpinus* | x | | x | |
| *Rhizopogon exiguus* | x | | x | |
| *Rhizopogon flavofibrillosus* | x | | x | |
| *Rhizopogon inquinatus* | x | | x | |
| *Sedecula pulvinata* | x | | x | |
| | | | | |
| **Undescribed Taxa, Rare Truffles & False truffles** | | | | |
| *Alpova sp. nov. #Trappe 9730* | x | | x | |
| *Alpova sp. nov. #Trappe 1966* | x | | x | |
| *Arcangeliella sp. nov. #Trappe 12382* | x | | x | |
| *Arcangeliella sp. nov. #Trappe 12359* | x | | x | |
| *Chamonixia pacifica sp. nov. #Trappe 12768* | x | | x | |
| *Elaphomyces sp. nov. #Trappe 1038* | x | | x | |
| *Gastroboletus sp. nov. #Trappe 2897* | x | | x | |
| *Gastroboletus sp. nov. #Trappe 7515* | x | | x | |
| *Gastrosuillus sp. nov. #Trappe 7516* | x | | x | |
| *Gastrosuillus sp. nov. #Trappe 9608* | x | | x | |
| *Gymnomyces sp. nov. #Trappe 4703, 5576* | x | | x | |
| *Gymnomyces sp. nov. #Trappe 5052* | x | | x | |
| *Gymnomyces sp. nov. #Trappe 1690,1706,1710* | x | | x | |
| *Gymnomyces sp. nov. #Trappe 7545* | x | | x | |
| *Hydnotrya sp. nov. #Trappe 787, 792* | x | | x | |
| *Hydnotrya subnix sp. nov. #Trappe 1861* | x | | x | |
| *Martellia sp. nov. #Trappe 649* | x | | x | |
| *Martellia sp. nov. #Trappe 1700* | x | | x | |
| *Martellia sp. nov. #Trappe 311* | x | | x | |
| *Martellia sp. nov. #Trappe 5903* | x | | x | |
| *Octavianina sp. nov. #Trappe 7502* | x | | x | |
| *Rhizopogon sp. nov. #Trappe 9432* | x | | x | |
| *Rhizopogon sp. nov. #Trappe 1692* | x | | x | |
| *Rhizopogon sp. nov. #Trappe 1698* | x | | x | |
| *Thaxterogaster sp. nov. #Trappe 4867,6242,7427,7962,8520* | x | | x | |
| *Tuber sp. nov. #Trappe 2302* | x | | x | |
| *Tuber sp. nov. #Trappe 12493* | x | | x | |
| | | | | |
| **Rare Truffles** | | | | |
| *Balsamia nigra* | x | | x | |
| *Choiromyces alveolatus* | x | | x | |
| *Choiromyces venosus* | x | | x | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| **Rare Truffles (continued)** | | | | |
| *Elaphomyces anthracinus* | x | | x | |
| *Elaphomyces subviscidus* | x | | x | |
| **Chanterelles** | | | | |
| *Cantharellus cibarius* | | | x | x |
| *Cantharellus subalbidus* | | | x | x |
| *Cantharellus tubaeformis* | | | x | x |
| **Chanterelles - Gomphus** | | | | |
| *Gomphus bonarii* | | | x | |
| *Gomphus clavatus* | | | x | |
| *Gomphus floccosus* | | | x | |
| *Gomphus kauffmanii* | | | x | |
| **Rare Chanterelle** | | | | |
| *Cantharellus formosus* | x | | x | |
| *Polyozellus multiplex* | x | | x | |
| **Uncommon Coral Fungi** | | | | |
| *Ramaria abietina* | | | x | |
| *Ramaria araiospora* | x | | x | |
| *Ramaria botryis var. aurantiiramosa* | x | | x | |
| *Ramaria concolor f. tsugina* | | | x | |
| *Ramaria coulterae* | | | x | |
| *Ramaria fasciculata var. sparsiramosa* | x | | x | |
| *Ramaria gelatiniaurantia* | x | | x | |
| *Ramaria largentii* | x | | x | |
| *Ramaria rubella var. blanda* | x | | x | |
| *Ramaria rubrievanescens* | x | | x | |
| *Ramaria rubripermanens* | x | | x | |
| *Ramaria suecica* | | | x | |
| *Ramaria thiersii* | x | | x | |
| **Rare Coral Fungi** | | | | |
| *Ramaria amyloidea* | x | | x | |
| *Ramaria aurantiisiccescens* | x | | x | |
| *Ramaria celerivirescens* | x | | x | |
| *Ramaria claviramulata* | x | | x | |
| *Ramaria concolor f. marri* | x | | x | |
| *Ramaria cyaneigranosa* | x | | x | |
| *Ramaria hilaris var. olympiana* | x | | x | |
| *Ramaria lorithamnus* | x | | x | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Rare Coral Fungi (continued)** | | | | |
| *Ramaria maculatipes* | x | | x | |
| *Ramaria rainierensis* | x | | x | |
| *Ramaria rubribrunnescens* | x | | x | |
| *Ramaria stuntzii* | x | | x | |
| *Ramaria verlotensis* | x | | x | |
| *Ramaria gracilis* | x | | x | |
| *Ramaria spinulosa* | x | | x | |
| **Phaeocollybia** | | | | |
| *Phaeocollybia attenuata* | | | x | |
| *Phaeocollybia californica* | x | | x | |
| *Phaeocollybia carmanahensis* | x | | x | |
| *Phaeocollybia dissiliens* | x | | x | |
| *Phaeocollybia fallax* | | | x | |
| *Phaeocollybia gregaria* | x | | x | |
| *Phaeocollybia kauffmanii* | x | | x | |
| *Phaeocollybia olivacea* | | | x | |
| *Phaeocollybia oregonensis* | x | | x | |
| *Phaeocollybia piceae* | x | | x | |
| *Phaeocollybia pseudofestiva* | | | x | |
| *Phaeocollybia scatesiae* | x | | x | |
| *Phaeocollybia sipei* | x | | x | |
| *Phaeocollybia spadicea* | | | x | |
| **Uncommon Gilled Mushrooms** | | | | |
| *Catathelasma ventricosa* | | | x | |
| *Cortinarius azureus* | | | x | |
| *Cortinarius boulderensis* | x | | x | |
| *Cortinarius cyanites* | | | x | |
| *Cortinarius magnivelatus* | x | | x | |
| *Cortinarius olympianus* | x | | x | |
| *Cortinarius spilomius* | | | x | |
| *Cortinarius tabularis* | | | x | |
| *Cortinarius valgus* | | | x | |
| *Dermocybe humboldtensis* | x | | x | |
| *Hebeloma olympiana* | x | | x | |
| *Hygrophorus caeruleus* | x | | x | |
| *Hygrophorus karstenii* | | | x | |
| *Hygrophorus vernalis* | x | | x | |
| *Russula mustelina* | | | x | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Rare Gilled Mushrooms** | | | | |
| *Chroogomphus loculatus* | x | | x | |
| *Cortinarius canabarba* | x | | x | |
| *Cortinarius rainierensis* | x | | x | |
| *Cortinarius variipes* | x | | x | |
| *Cortinarius verrucisporus* | x | | x | |
| *Cortinarius wiebeae* | x | | x | |
| *Tricholoma venenatum* | x | | x | |
| **Uncommon Ecto-Polypores** | | | | |
| *Albatrellus ellisii* | | | x | |
| *Albatrellus flettii* | | | x | |
| **Rare Ecto-Polypores** | | | | |
| *Albatrellus avellaneus* | x | | x | |
| *Albatrellus caeruleoporus* | x | | x | |
| **Tooth Fungi** | | | | |
| *Hydnum repandum* | | | x | |
| *Hydnum umbilicatum* | | | x | |
| *Phellodon atratum* | | | x | |
| *Sarcodon fuscoindicum* | | | x | |
| *Sarcodon imbricatus* | | | x | |
| **Rare Zygomycetes** | | | | |
| *Endogone acrogena* | x | | x | |
| *Endogone oregonensis* | x | | x | |
| *Glomus radiatum* | x | | x | |
| **Saprobes (Decomposers)** | | | | |
| **Uncommon Gilled Mushrooms** | | | | |
| *Baeospora myriadophylla* | | | x | |
| *Chrysomphalina grossula* | | | x | |
| *Collybia bakerensis* | x | | x | |
| *Fayodia gracilipes (rainierensis)* | | | x | |
| *Gymnopilus puntifolius* | x | | x | |
| *Marasmius applanatipes* | x | | x | |
| *Mycena hudsoniana* | x | | x | |
| *Mycena lilacifolia* | | | x | |
| *Mycena marginella* | | | x | |
| *Mycena monticola* | x | | x | |
| *Mycena overholtsii* | x | | x | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Uncommon Gilled Mushrooms (continued)** | | | | |
| *Mycena quinaultensis* | x | | x | |
| *Mycena tenax* | | | x | |
| *Mythicomyces corneipes* | | | x | |
| *Neolentinus kauffmanii* | x | | x | |
| *Pholiota albivelata* | x | | x | |
| *Stagnicola perplexa* | | | x | |
| **Rare Gilled Mushrooms** | | | | |
| *Clitocybe subditopoda* | x | | x | |
| *Clitocybe senilis* | x | | x | |
| *Neolentinus adherens* | x | | x | |
| *Rhodocybe nitida* | x | | x | |
| *Rhodocybe speciosa* | x | | x | |
| *Tricholomopsis fulvescens* | x | | x | |
| **Noble Polypore (rare and endangered)** | | | | |
| *Oxyporus nobilissimus* | x | x | x | |
| **Bondarzewia Polypore** | | | | |
| *Bondarzewia montana* | x | x | x | |
| **Rare Resupinates and Polypores** | | | | |
| *Aleurodiscus farlowii* | x | | x | |
| *Dichostereum granulosum* | x | | x | |
| *Cudonia monticola* | | | x | |
| *Gyromitra californica* | | | x | x |
| *Gyromitra esculenta* | | | x | x |
| *Gyromitra infula* | | | x | x |
| *Gyromitra melaleucoides* | | | x | x |
| *Gyromitra montana (syn. G. gigas)* | | | x | x |
| *Otidea leporina* | | | x | |
| *Otidea onotica* | | | x | |
| *Otidea smithii* | x | | x | |
| *Plectania melastoma* | | | x | |
| *Podostroma alutaceum* | | | x | |
| *Sarcosoma mexicana* | | | x | |
| *Sarcosphaera eximia* | | | x | |
| *Spathularia flavida* | | | x | |
| **Rare Cup Fungi** | | | | |
| *Aleuria rhenana* | | | | |
| *Bryoglossum gracile* | | | | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

**Table B11-1. (continued)**

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Rare Cup Fungi (continued)** | x | | x | |
| *Gelatinodiscus flavidus* | | | | |
| *Helvella compressa* | x | | x | |
| *Helvella crassitunicata* | x | | x | |
| *Helvella elastica* | x | | x | |
| *Helvella maculata* | x | | x | |
| *Neournula pouchetii* | x | | x | |
| *Pithya vulgaris* | x | | x | |
| *Plectania latahensis* | x | | x | |
| *Plectania milleri* | x | | x | |
| *Pseudaleuria quinaultiana* | x | | x | |
| **Club Coral Fungi** | | | | |
| *Clavariadelphus ligula* | | | x | x |
| *Clavariadelphus pistilaris* | | | x | x |
| *Clavariadelphus truncatus* | | | x | x |
| *Clavariadelphus borealis* | | | x | x |
| *Clavariadelphus lovejoyae* | | | x | x |
| *Clavariadelphus sachalinensis* | | | x | x |
| *Clavariadelphus subfastigiatus* | | | x | x |
| | | | x | x |
| **Jelly Mushroom** | | | | |
| *Phlogoitis helvelloides* | | | x | x |
| **Branched Coral Fungi** | | | | |
| *Clavulina cinerea* | | | x | x |
| *Clavulina cristata* | | | x | x |
| *Clavulina ornatipes* | | | x | x |
| **Mushroom Lichen** | | | | |
| *Phytoconis ericetorum* | | | x | x |
| **Parasitic Fungi** | | | | |
| *Asterophora lycoperdoides* | | | x | |
| *Asterophora parasitica* | | | x | |
| *Collybia racemosa* | | | x | |
| *Cordyceps capitata* | | | x | |
| *Cordyceps ophioglossoides* | | | x | |
| *Hypomyces luteovirens* | | | x | |
| **Cauliflower Mushroom** | | | | |
| *Sparassis crispa* | | | x | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Moss Dwelling Mushrooms** | | | | |
| *Cyphellostereum laeve* | | | x | |
| *Galerina atkinsoniana* | | | x | |
| *Galerina cerina* | | | x | |
| *Galerina heterocystis* | | | x | |
| *Galerina sphagnicola* | | | x | |
| *Galerina vittaeformis* | | | x | |
| *Rickenella setipes* | | | x | |
| **Coral Fungi** | | | | |
| *Clavicorona avellanea* | | | x | |
| **Lichens** | | | | |
| **Rare Forage Lichen** | | | | |
| *Bryoria tortuosa* | x | | x | |
| **Rare Leafy (arboreal) Lichens** | | | | |
| *Hypogymnia duplicata* | x | x | x | |
| *Tholurna dissimilis* | x | | x | |
| **Rare Nitrogen-fixing Lichens** | | | | |
| *Dendriscocaulon intricatulum* | x | | x | |
| *Lobaria hallii* | x | | x | |
| *Lobaria linita* | x | x | x | |
| *Nephroma occultum* | x | | x | |
| *Pannaria rubiginosa* | x | | x | |
| *Pseudocyphellaria rainierensis* | x | x | x | |
| **Nitrogen-fixing Lichens** | | | | |
| *Lobaria oregana* | | | | x |
| *Lobaria pulmonaria* | | | | x |
| *Lobaria scrobiculata* | | | | x |
| *Nephroma bellum* | | | | x |
| *Nephroma helveticum* | | | | x |
| *Nephroma laevigatum* | | | | x |
| *Nephroma parile* | | | | x |
| *Nephroma resupinatum* | | | | x |
| *Pannaria leucostictoides* | | | | x |
| *Pannaria mediterranea* | | | | x |
| *Pannaria saubinetii* | | | | x |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Nitrogen-fixing Lichens (continued)** | | | | |
| *Peltigera collina* | | | | x |
| *Peltigera neckeri* | | | | x |
| *Peltigera pacifica* | | | | x |
| *Pseudocyphellaria anomala* | | | | x |
| *Pseudocyphellaria anthraspis* | | | | x |
| *Pseudocyphellaria crocata* | | | | x |
| *Sticta beauvoisii* | | | | x |
| *Sticta fuliginosa* | | | | x |
| *Sticta limbata* | | | | x |
| **Pin Lichens** | | | | |
| *Calicium abietinum* | | | | x |
| *Calicium adaequatum* | | | | x |
| *Calicium adspersum* | | | | x |
| *Calicium glaucellum* | | | | x |
| *Calicium viride* | | | | x |
| *Chaenotheca brunneola* | | | | x |
| *Chaenotheca chrysocephala* | | | | x |
| *Chaenotheca ferruginea* | | | | x |
| *Chaenotheca furfuracea* | | | | x |
| *Chaenotheca subroscida* | | | | x |
| *Chaenothecopis pusilla* | | | | x |
| *Cyphelium inquinans* | | | | x |
| *Microcalicium arenarium* | | | | x |
| *Mycocalicium subtile* | | | | x |
| *Stenocybe clavata* | | | | x |
| *Stenocybe major* | | | | x |
| **Rare Rock Lichens** | | | | |
| *Pilophorus nigricaulis* | x | | x | |
| *Sticta arctica* | x | | x | |
| **Riparian Lichens** | | | | |
| *Cetrelia cetrarioides* | | | | x |
| *Collema nigrescens* | | | | x |
| *Leptogium burnetiae var. hirsutum* | | | | x |
| *Leptogium cyanescens* | | | | x |
| *Leptogium saturninum* | | | | x |
| *Leptogium teretiusculum* | | | | x |
| *Platismatia lacunosa* | | | | x |
| *Ramalina thrausta* | | | | x |
| *Usnea longissima* | | | | x |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| **Aquatic Lichens** | | | | |
| *Dermatocarpon luridum* | X | | X | |
| *Hydrothyria venosa* | X | | X | |
| *Leptogium rivale* | X | | X | |
| **Rare Oceanic Influenced Lichens** | | | | |
| *Bryoria pseudocapillaris* | X | | X | |
| *Bryoria spiralifera* | X | | X | |
| *Bryoria subcana* | X | | X | |
| *Buellia oidalea* | X | | X | |
| *Erioderma sorediatum* | X | | X | |
| *Hypogymnia oceanica* | X | | X | |
| *Leioderma sorediatum* | X | | X | |
| *Leptogium brebissonii* | X | | X | |
| *Niebla cephalota* | X | | X | |
| *Pseudocyphellaria mougeotiana* | X | | X | |
| *Teloschistes flavicans* | X | | X | |
| *Usnea hesperina* | X | | X | |
| **Oceanic Influenced Lichens** | X | | X | |
| *Cetraria californica* | X | | X | |
| *Heterodermia leucomelos* | X | | X | |
| *Loxospora sp nov. "corallifera" (Brodo in edit)* | X | | X | |
| *Pyrrhospora quernea* | | | | |
| **Additional Lichen Species** | | | | |
| *Cladonia norvegica* | | | X | |
| *Heterodermia sitchensis* | | | X | |
| *Hygomnia vittiata* | | | X | |
| *Hypotrachyna revoluta* | | | X | |
| *Ramalina pollinaria* | | | X | |
| *Nephroma isidiosum* | | | X | |
| **Bryophytes** | | | | |
| *Antitrichia curtipendula* | | | | X |
| *Bartramiopsis lescurii* | X | | X | |
| *Brotherella roelli* | X | | X | |
| *Diplophyllu albicans* | X | | X | |
| *Diplophyllum plicatum* | X | X | | |
| *Douinia ovata* | | | | X |
| *Encalypta brevicolla var. crumiana* | X | | X | |
| *Herbertus aduncus* | X | | X | |
| *Herbertus sakurali* | X | | X | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

Table B11-1. (continued)

| Species | Survey Strategies | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| **Bryophytes (continued)** | | | | |
| *Iwatsuklella leucotricha* | x | | x | |
| *Kurzia makinoana* | x | x | | |
| *Marsupella emarginata var. aquatica* | x | x | | |
| *Orthodontlum gracile* | x | | x | |
| *Plagiochila satol* | x | | x | |
| *Plagiochila semidecurrens* | x | | x | |
| *Pleuroziopsis ruthenica* | x | | x | |
| *Ptilidium californicum* | x | x | | |
| *Racomitrium aquaticum* | x | | x | |
| *Radula brunnea* | x | | x | |
| *Scouleria marginata* | | | | x |
| *Tetraphis geniculata* | x | | x | |
| *Tritomaria exsectiformis* | x | x | | |
| *Tritomaria quinquedentata* | x | | x | |
| **Amphibians** | | | | |
| Del Norte salamander | | x | | |
| Larch Mountain salamander | | x | | |
| Shasta salamander | x | x | | |
| Siskiyou Mountains salamander | x | x | | |
| Van Dyke's salamander (Cascades) | | x | | |
| **Mammals** | | | | |
| *Red tree vole (P. longicaudus)* | | x | | |
| **Mollusks** | | | | |
| | x | x | | |
| *Cryptomastix hendersoni* | x | x | | |
| *Helminthoglypta hertleini* | x | x | | |
| *Helminthoglypta talmadgei* | x | x | | |
| *Megomphix hemphilli* | x | x | | |
| *Monadenia chaceana* | x | x | | |
| *Monadenia churchi* | x | x | | |
| *Monadenia fidelis minor* | x | x | | |
| *Monadenia troglodytes troglodytes* | x | x | | |
| *Monadenia troglodytes wintu* | x | x | | |
| *Oreohelix n. sp.* | x | x | | |
| *Pristiloma articum crateris* | x | x | | |
| *Trilobopsis roperi* | x | x | | |
| *Trilobopsis tehamana* | x | x | | |
| *Vertigo n. sp.* | x | x | | |

Survey Strategies: 1 = manage known sites; 2 = survey prior to activities and manage sites; 3 = conduct extensive surveys and manage sites; 4 = conduct general regional surveys.

# Appendix B4
# Protection Buffers

Protection buffers are additional standards and guidelines for specific rare and locally endemic species, and other specific species in the upland forest matrix, from the Scientific Analysis Team Report (Thomas et al. 1993).

The Forest Service's Scientific Analysis Team (SAT) examined the effects of Forest Plans and the Interagency Scientific Committee (ISC) Conservation Strategy on the amount and distribution of habitat to support the viability of species other than the northern spotted owl associated with late-successional forests on lands administered by the Forest Service. The Scientific Analysis Team determined that these plans would not provide and manage habitat to achieve at least a medium-high likelihood of supporting a stable population of all such species and proposed a series of mitigation steps to be applied to Forest Plans. Those mitigation recommendations were reexamined by the Forest Ecosystem Management Assessment Team and incorporated, as appropriate, into the action alternatives. Two of the mitigation steps recommended by the Scientific Analysis Team provided specific standards and guidelines for survey and protection of rare and locally endemic species, and for other species in the upland forests. These standards and guidelines would be applied wherever the species occurs outside of designated areas. The Assessment Team applied these, as written by the Scientific Analysis Team, to Alternatives 1, 3, 4, 5, and, with the exception of those pertaining to American marten, Alternative 9. The standards and guidelines apply to the lands administered by the Forest Service and BLM.

Some of the mitigation steps would create additional Late-Successional Reserves, some would create additional Managed Late-Successional Areas, and others would add additional matrix standards and guidelines. The following table identifies mitigation steps as described in the SAT Report that create

**Table B4-1.** Mitigation steps from the Scientific Analysis Team Report (Thomas et al. 1993) that apply to Alternatives 1, 3, 4, 5, and (excepting American marten) Alternative 9 in this SEIS. Numbers and letters refer to the specific mitigation steps described in the following pages of text.

| | Late-Successional Reserves | Managed Late-Successional Areas | Matrix Standards and Guidelines |
|---|---|---|---|
| **SAT Step 5** | | | |
| Nonvascular plants | 1a, b, e, f | 1c, d, g, h | |
| Invertebrates | (No protection areas identified for specific species | | |
| Amphibians | 3c | 3a, b | |
| **SAT Step 6** | | | |
| Amphibians | | 1 | |
| Birds | 2b | | 2a |
| Mammals | 3a (except Alt. 9) | | 3b |

(e) ***Aleuria rhenana*** (Fungus) - This mushroom is widely distributed but rare and little known throughout its range, known from one collection from Mt. Rainier National Park. It is a conifer litter decomposer. Mitigation activities include conducting ecological studies and surveys to determine localities. Protect known populations if surveys continue to indicate that the population is rare. Defer ground-disturbing activities.

(f) ***Otidea leporina, O. onotica,*** and ***O.smithii*** (Fungi) - These mushrooms occur in conifer duff, and are widespread in distribution but uncommon. They are dependent on older-age forests. Specific mitigation options include protecting older forests from ground disturbance where the species are located.

(g) ***Polyozellus multiplex*** (Fungus) - Ecologically, this mushroom was considered by the nonvascular expert panel in the same species group as *Albatrellus caeryliopus* and others, listed [earlier in the SAT Report] under species aided by marbled murrelet mitigation measures. However, *P. multiplex* occurs in higher elevation[s] of the Cascades in silver fir and mixed conifer (and is thus outside the range of marbled murrelet mitigations). It can be locally abundant and is a mycorrhizal species important to forest health. Like its group associates, it is a good indicator of old-growth forests. Mitigation activities for this species include conducting surveys to define its distribution, and studies to assess its habitat requirements.

(h) ***Sarcosoma mexicana*** (Fungus) - This mushroom occurs in deep conifer litter layers in older forests. It is uncommon to rare and is found in the Oregon and Washington Coast Range into British Columbia. Mitigation activities include surveying for locations and protecting deep litter layers of older forests where found. Defer prescribed burning of understory or other activities which would not retain a deep litter layer.

For all of the plants listed in this mitigation step, and for those listed in the next step, [the Scientific Analysis Team] recommend[s] that Regional ecologists or botanists should: (1) maintain a spatially explicit data base of all known sites in National Forests, and (2) develop species or area management plans, to be implemented under the guidance of the regional botany programs.

### (2) Invertebrates:

Although lack of information prevented analyzing mitigation needs for specific invertebrate species, Olson (1992) underscored the need for surveys for species that are rare or locally endemic. Within the range of the northern spotted owl, invertebrates are noted for their high frequency of endemism (species found nowhere else) and restricted ranges (Lattin 1993). Centers of invertebrate biodiversity include, in particular, the Olympic Peninsula and its south coast, the southern Oregon Cascades, the Klamath Physiographic Province, several isolated volcanic peaks including Mt. Hood and the Three Sisters in the Oregon Cascades, and the coastal forests of Oregon and California (Lattin 1993). In addition, some species are poor dispersers or rely on special habitats including decaying wood or aquatic environments (Lattin and Moldenke 1992).

Frest and Johannes (1991) identified endemic species complexes of terrestrial mollusks (bivalves and snails) in the west coast states, particularly limited to the areas from the Cascades crest to the coast. As summarized by Anthony et al. (1992:348-349) [USDI 1992], Late-Successional Reserves and Managed Late-Successional Areas, and that add additional matrix standards and guidelines.

These recommendations, from Thomas et al. (1993) pages 291-299, are as follows:

SAT MITIGATION STEP 5: Standards and Guidelines for Rare and Locally Endemic Species

The following rare and locally endemic species are likely to be assured viability if they occur within Habitat Conservation Areas. However, there might be occupied locations outside these areas that will be important to protect as well. [The Scientific Analysis Team] therefore recommend[s] that protocols for surveys be developed that will ensure a high likelihood of locating these occupied sites. Prior to ground-disturbing activities, surveys using the protocol must be conducted within the known or suspected ranges and within the habitat types or vegetation communities occupied by the species. When located, the occupied sites need to be protected as indicated below.

### (1) Nonvascular Plants:

**(a) *Ptilidium californicum*** (Liverwort) - This species is rare and has a very limited distribution in old white fir forests with fallen trees. It occurs on trunks of trees at about 5000-feet elevation. Mitigation options include finding locations and maintaining stands of overmature white fir at about 5000-feet elevation for inoculum and dispersal along corridors; and studying specific distribution patterns. Protect known occupied locations if distribution patterns are disjunct and highly localized, by deferring timber harvest and avoiding removal of fallen trees and logs.

**(b) *Ulota meglospora*** (Moss) - This species occurs in northern California and southwest Oregon. It is best developed (locally abundant) in very old stands of tanoak, Douglas-fir, and other conifer species further north, but is generally scarce throughout its range. The species is poorly known ecologically. Mitigation activities include conducting basic ecological studies, and surveying for presence, particularly in Oregon. Protect known occupied sites if distribution patterns are disjunct and highly localized. Defer timber harvest or other activities which would not maintain desired habitat characteristics and population levels.

**(c) *Brotherella roellii*** (Moss) - This very rare species is endemic to the Washington Cascades north of Snoqualmie Pass. It occupies rotting logs in low to mid-elevation old-growth stands having dense shade, closed canopies, and high humidity. Mitigation options include locating specific populations and protection of large decay class 3, 4, and 5 logs and >70 percent canopy closure. Defer management activities conflicting with maintaining suitable habitat characteristics and known populations levels.

**(d) *Buxbaumia piperi, B. viridis, Rhizomnium nudum, Schistostega pennata,* and *Tetraphis geniculata*** (Mosses) - Most of these species are fairly rare (the exception is *B. piperi*). They occur on rotten logs and some organic soil, and are shade-dependent, occurring in old-growth forests. *S. pennata* occurs only in mature western red-cedar forests in the Olympic National Forest and in [the] Washington Cascades. Mitigation activities include surveying to determine presence and distribution; and, where located, maintaining decay class 3, 4, and 5 logs and >70 percent closed-canopy forest habitats for shade. Shelterwood and thinning prescriptions for timber harvest will cause their demise, as logs dry out.

# Appendix J
## Technical Information

This appendix consists of a variety of documents and working papers that provide technical information and support to the analysis in this Final Supplemental Environmental Impact Statement.

**Organization of This Appendix**

This appendix consists of the following documents and working papers:

1. *Estimation of Vital Rates of the Northern Spotted Owl* by K.P. Burnham, D.R. Anderson and G.C. White. This 44 page paper consists of an analysis of spotted owl demographic data collected at study areas throughout the owl's range. The results include the rate of population change for the individual study areas, as well as for the population as a whole.
2. *Results of Additional Species Analysis.* A presentation of the results of an analysis, of more than 427 species, that was conducted by the Species Analysis Team. This paper includes:
    - a discussion of the process used for this analysis,
    - a list of all species that were reviewed (with rationale for analysis),
    - a summary report on the effects of mitigations for all species, and
    - a species-by-species write-up of the basis for the FEMAT rating and possible mitigations considered.
3. *Additional analysis and discussion.* Additional analysis and discussion of spotted owl and marbled murrelet issues, including preliminary information on modeling.

Because of the substantial volume of this material (over 700 pages), Parts 2 and 3 are an uncirculated portion of this appendix and are available on request. To receive a copy of Parts 2 and 3 of Appendix J, send a request in writing to:

Appendix J Request
Interagency SEIS Team
P. O. Box 3623
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# Appendix J2
## Results of Additional Species Analysis

### Prepared by Species Analysis Team

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# Appendix J2
# Methods of Additional Species Analysis for the Final SEIS

## Introduction and Objectives

Additional analysis was conducted, between the Draft and Final SEIS, on many of the late-successional and old-growth related species within the range of the northern spotted owl. While the analysis was focused on responding to public comments on the preferred alternative (Alternative 9), much of it is also pertinent to the other nine alternatives.

The additional analysis had the following objectives:

- Identify species for which additional consideration and analysis is appropriate;
- Generate additional information on the impacts of activities on nonfederal lands and other sources of cumulative effects;
- Explain, in more detail, the basis for the ratings provided in the Forest Ecosystem Management Assessment Team (FEMAT) Report (Appendix A) and Draft SEIS for selected species; and
- Provide detailed specifications of mitigation measures that could be employed, and the relative benefits and costs of implementing those measures.

Because the original species assessments were done by the Assessment Team, original members were asked to provide additional analysis. Wherever possible, the Assessment Team member who originally dealt with a specific taxon was asked to provide the additional input for that taxon. In a few instances, assignments had to either be shifted, or new species experts recruited, to deal with a specific taxon. The group that completed this additional analysis is hereafter referred to as the Species Analysis Team in order to distinguish it from the original Assessment Team. The individuals who contributed to this analysis are listed in the front of this Appendix.

Wherever possible, information was sought from individuals who had participated in the original assessment panels. The assessment panels themselves, however, were not reconvened. The judgements reported here are not the result of the formal expert opinion process used during the Assessment Team's efforts. Instead, they reflect the judgements of the Species Analysis Team. These judgements were based on information contained in the FEMAT report, individual knowledge, and consultation with some individual species experts.

# Description of the Process

The process had six main steps:

## Step 1: Screen Species for Further Analysis

To identify species for further analysis, four separate screens were used. Although applicable laws were considered in the development of these screens, it is important to note that the screening levels do not represent a judgement about what is required by either the National Forest Management Act (NFMA) or the Endangered Species Act (ESA). Use of the screens was intended to produce a list of species for which further investigation might prove useful or necessary.

**Screen #1** - Species screened based on their rating in the FEMAT Report - The first screen was to identify those species for which additional analysis might be useful in light of the original assessment they received. The following screening levels were adopted:

- For vertebrates, reexamine all species with a likelihood of Outcome A of less than 80 percent, or any percent likelihood of Outcome D.
- For all other taxa, reexamine all species with a combined likelihood of Outcomes C and D of 20 percent or more, or any percent likelihood of Outcome D.

Outcomes A, B, C, and D refer to the system that was used for the original species ratings. These outcomes were intended to describe the amount, quality, and distribution of habitat that would be provided for each species. The outcomes were defined as:

A Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, well distributed across federal lands. (Note that the concept of well distributed must be based on knowledge of the species distribution, range, and life history).

B Habitat is of sufficient quality, distribution, and abundance to allow the species population to stabilize, but with significant gaps in the historic species distribution on federal land. These gaps cause some limitation in interactions among local populations. (Note that the significance of the gaps must be judged relative to the species distribution, range, and life history, and the concept of metapopulations).

C Habitat only allows continued species existence in refugia, with strong limitations on interactions among local populations.

D Habitat is inadequate to maintain the species and would result in species extirpation from federal land within the range of the northern spotted owl.

**Screen #2** - Species screened considering post-Draft SEIS changes to Alternative 9 - Several features of Alternative 9 were expected to change due to public and internal comment. Some species that would otherwise have passed the FEMAT-rating screen were considered because of these expected changes.

**Screen #3** - Species screened based on cumulative effects - The ratings done by the Assessment Team were based on the management of habitat on federal lands under the different alternatives. The Assessment Team and panelists did not explicitly evaluate cumulative effects including habitat conditions on nonfederal lands, other threats to the species population on nonfederal lands, or other influences such as hunting, trapping, or water quality resulting from non-federal actions. Species were identified for further analysis if they were potentially adversely affected by cumulative effects. In order to determine if any species required further analysis due to cumulative effects, the Species Analysis Team asked three primary questions. (1) Would the outcome for the total species population differ from the outcome projected in the FEMAT Report which was based only on habitat management of federal lands? (2) Would cumulative effects create a risk of extirpation of any species from federal land that was not projected as being at risk in the FEMAT Report? (3) Would cumulative effects contribute significantly to a risk of extirpation of any species from federal land that had already been projected as being at risk in the FEMAT Report? If such effects were foreseen for any species, that species was added to the group that was to be further analyzed.

**Screen #4** - Species screened based on additional species-specific criteria - Some species that did not meet the above guidelines were selected for further consideration. For example, a species on a Regional Forester's sensitive list could be subject to additional analysis even though the species did not specifically meet the above criteria.

Based on the screening process, 486 species and 4 groups of insects were identified for additional analysis (Table J2-1). This included northern spotted owls and marbled murrelets for which additional analysis was done based on issues raised in the Draft Biological Opinion.

Table J2-1. Comparison between species/ranges/groups assessed in the FEMAT Report and those for which additional analysis was done.

| Species group | Species/ranges/groups assessed in FEMAT | Species/ranges/groups in additional analysis |
|---|---|---|
| Bryophytes | 106 | 9 |
| Fungi | 527 | 255 |
| Lichens | 157 | 75 |
| Vascular plants | 124 | 17 |
| Arthropods (groups or ranges) | 15 | 4 |
| Mollusks | 102 | 97 |
| Amphibians | 18 | 12 |
| Fish (races/species/groups) | 7 | 7 |
| Birds | 36 | 2 |
| Bats | 11 | 7 |
| Other mammals | 15 | 3 |
| Northern spotted owls | 1 | 1 |
| Marbled murrelets | 1 | 1 |
| Total | 1120 | 490 |

## Step 2: Describe in Detail the Basis for the Original Species Rating, and/or the Basis for Concern About Cumulative Effects

For each of the species selected in the above screens, a detailed description and interpretation was provided of the basis for the species rating in the FEMAT report, the basis for reassessment given proposed changes to Alternative 9, and/or the basis for concern about cumulative effects. In the process of completing these descriptions, original assessment panel notes were consulted, as well as detailed maps of Alternative 9 and of species' ranges and locations; original literature sources for the species; and information on the portion of the species' range and/or locations included within reserves. Updated information was sought from State Natural Heritage Program data bases, and new herbarium searches were conducted for lichens.

The additional analysis for some species was more detailed than the original assessment, and/or included new information that was not reasonably available at the time of the original assessment. In some cases, this additional information provided the basis for reinterpreting the assessments in the FEMAT Report. Where this occurred, it is noted in the species discussions later in this appendix.

In developing the detailed descriptions of the species' rating, the Species Analysis Team considered the contribution that each of the following factors may have made to the original rating.

- **Natural History** - In some cases, the species may be known from only a few sites or from within a very limited distribution. In other cases, the species habitat, and thus its distribution, may be naturally fragmented.

- **Past Actions** - In some cases, the species' habitat has been severely impacted and/or fragmented by previous actions, and can only recover slowly. In other cases, the species has already been extirpated from significant parts of its range, and recolonization is problematic.

- **Species' Range** - A large portion of a species' range may lie outside the range of the northern spotted owl. In other cases, a large portion of a species' range may occur on nonfederal land.

- **Non-habitat Factors** - Factors such as hunting, fishing, air and water quality, and climate can influence the likely future for some species.

- **Inadequate Information** - In some cases, the species' rating may be largely a reflection of scientific uncertainty due to the lack of available information about a species.

- **Features of the Alternative** - The specific features of the alternatives were intended to play a primary role in determining the species' rating. For this analysis, the Species Analysis Team attempted to detail the specific features of the alternative that most influenced the original rating. This information was a critical building block for designing mitigation measures.

In addition to the above factors, the possible role of cumulative effects was examined for each species in this analysis. This included species that were specifically analyzed because of cumulative effects, as well as species that were analyzed based on other screens. The Species Analysis Team assessed the role that cumulative effects might play in determining the species' future, and whether cumulative effects had already been accounted for in the FEMAT rating. Even though the original Assessment Team ratings of habitat outcomes for federal land were supposed to be independent of cumulative effects, in practice it was very difficult to separate federal habitat from other influences on some species. In this most recent analysis, discussions of cumulative effects include the effects of species' range, non-federal habitat management, and non-habitat factors.

Based on the above discussions, a summary statement was provided describing the likely future outcome for each species. This summary provided clarification of the reasoning behind the species rating in the FEMAT Report. The summaries enabled the Species Analysis Team to distinguish between situations, for example, where a species received a particular rating because of naturally fragmented habitat, and situations where a species received a particular rating because the proposed action in the alternative was likely to further fragment its habitat. The summaries also provided new information on cumulative effects and likely effects of changes that had been proposed to Alternative 9.

## Step 3: Describe Possible Mitigation Measures

Possible mitigation measures were developed in conjunction with individual species experts. The mitigation measures were designed primarily to modify features of Alternative 9, but any or all of these mitigation measures could be combined with any of the alternatives. In many cases, the possible measures are simply components of other alternatives in which the species outcome rated higher. In other cases, the mitigation measure would prescribe actions to be taken when very localized actions are planned. These mitigation measures were intended to address the rare and narrowly-distributed species. Finally, some mitigation measures were intended to offset the possible negative consequences of cumulative effects.

In all cases, the overall objective of possible mitigation measures was to bring the species to a point where it would pass through all the screens described in Step 1, above. In some cases, this objective was either not possible, or could only be accomplished by adoption of another alternative. In these cases, that conclusion is stated, but possible mitigation measures have been presented that would provide some benefit to the species. Mitigation measures have been described as specifically as possible to help determine the benefits of the mitigation.

## Step 4: Describe the Benefits of the Possible Mitigation

Benefits of the possible mitigation measures would have been best described by conducting a new species assessment using a similar process as that described in the FEMAT Report. However, a number of factors prevented such a reassessment. Instead, the Species Analysis Team provided qualitative statements about the efficacy of mitigation that was proposed for each species. Wherever possible, information was provided on the effectiveness of each component of the mitigation. For example, if species surveys are an important component of the mitigation measures, the reliability of those surveys in locating the species is described. Where several different possible levels of mitigation are proposed, the benefits of each of them is described individually.

## Step 5: Summarize Mitigation Measures for All Species

When work on individual species had been completed, mitigation measures for all species were summarized and combined. In many cases, mitigation measures that had been described for one species or one group of species proved appropriate for other species. Thus, after reviewing all the possible mitigation, the Species Analysis Team developed a consolidated list of 23 possible mitigation measures that encompassed all measures that had been described for individual species. This list is presented in Table J2-2. Chapter 3&4 contain more complete descriptions of measures that were incorporated into Standards and Guidelines for Alternative 9.

Table J2-2. Consolidated list of possible mitigation measures that were described for all species. The mitigation measure numbers correspond to their discussion in the text.

**Survey and Manage Measures**

1. Survey to acquire additional information and ascertain levels of protection. Species intended to benefit from this mitigation measure are arthropods, fungi, bryophytes, lichens, and mollusks. These groups of species are particularly poorly known. Many species have likely not yet been identified, and there is only general information available on the abundance and distribution of some known species. The information gathered through these efforts would be useful in refining the selected alternative to better provide for these species as part of the adaptive management process.
2. Survey for the species and manage individual sites where it is found. The "survey and manage" mitigation measure would have primary benefits to amphibians, bryophytes, mollusks, vascular plants, fungi, lichens, and arthropods. Measures to survey for species and manage newly discovered sites would be phased-in over a somewhat longer timeframe than the measures to manage currently known sites.
3. Manage currently known locations of the species. Standards for management (including protection of sites) of currently known locations are discussed in individual species writeups.

**Riparian Reserves**

4. Survey for the species, and apply Riparian Reserve Scenario 1 guidelines along intermittent streams and small headwaters where the species is found. Prior to land management activities, conduct surveys for stream-dwelling amphibians (Black Salamander, Cascade and Southern Torrent Salamanders, Cope's Giant Salamander, and Tailed Frog) and one vascular plant (*Corydalis aquae*) using established stream-survey protocol for amphibians and appropriate plant sampling methods. Surveys for amphibians would be conducted within permanently flowing streams and adjacent streamside habitats outside of Tier 1 Key Watersheds, including Adaptive Management Areas. Where any of the species occur, occupied stream segments would be protected through application of Riparian Reserve Scenario I standards and guidelines from the occupied site upstream to its origin. Until surveys were completed, this mitigation would apply throughout the potential range or the specified portions of the species range indicated in the species narrative later in this appendix.
5. Apply Riparian Reserve Scenario 1 on intermittent streams with anadromous salmon or trout throughout the range of the northern spotted owl. The reserve widths for intermittent streams are intended to be interim. They may be modified after completion of watershed analysis. That analysis would take into account all species that were intended to be benefited by this mitigation measure.
6. Apply Riparian Reserve Scenario 1 on intermittent streams with anadromous salmon or trout throughout the range of coho salmon.

7. Ensure that riparian management in Adaptive Management Areas provides species protection equivalent to that of Riparian Reserves. In most cases riparian protection in

(Table J2-2. continued)

Adaptive Management Areas should be comparable to that prescribed for other federal land allocations. However, in those cases where alternate means are proposed to meet riparian objectives, those alternate means must meet objectives for management of all species.

8. Provide additional buffers around all wetlands 1/8 to 1 acre in size (to the outer edges of the riparian vegetation). For the purposes of this mitigation measure, wetlands are defined as any areas that are inundated or saturated by surface or ground water to the extent that they support a prevalence of vegetation adapted for life in saturated soil conditions.

**Watershed Protections**

9. Apply greater protection to Tier 1 Key Watersheds by removing all lands within them from the suitable timber base.
10. Build no new roads in Tier 1 Key Watersheds.

**Matrix Management Provisions**

11. Provide specified amounts of coarse woody debris in matrix management. This mitigation measure was developed specifically for fungi, arthropods, bryophytes, American marten, fisher, two amphibians, and two species of vascular plants. The objective is to provide this substrate well distributed across the landscape in a manner which meets the needs of species and provides for ecological functions. Standards and guidelines would consider appropriate coarse woody debris quantity, quality (such as species, decay stage and size distribution) and distribution.
12. Emphasize clumped green tree and snag leave in matrix management. For most species, benefits would be greatest if trees were retained in patches rather than singly. Because very small patches do not provide suitable microclimates for many of these organisms, patches should generally be larger than 1 hectare. Retained patches should be protected for multiple rotations to provide support for those organisms that require very old forests.
13. Provide additional no-harvest buffers around cave entrances. Conduct surveys of crevices in caves, mines, and abandoned wooden bridges and buildings for the presence of roosting bats, including fringed myotis, silver-haired bats, long-eared myotis, long-legged myotis, and pallid bats. As an interim measure, timber harvest would be prohibited within 250 feet of sites containing bats. A management plan would be developed for each of these sites that includes an inventory and map of resources, and plans for protection of the site from destruction, vandalism, disturbance from road construction or blasting, or any other activity that could change cave or mine temperatures or drainage patterns. The size of the buffer could be modified through this plan based on site-specific needs.
14. Modify site treatment practices, particularly the use of fire and pesticides, and modify harvest methods to minimize soil and litter disturbance. Many species of soil and litter-dwelling organisms, such as fungi and arthropods, are sensitive to soil and litter disturbance. Site treatments would be prescribed which would minimize intensive burning, unless appropriate for certain specific habitats, communities or stand conditions. Site treatments should also minimize soil and litter disturbance which may occur as

(Table J2-2. continued)

a result of yarding and operation of heavy equipment, and reducing the intensity and frequency of stand treatments.

15. Provide dispersal corridors where needed in the range of red tree voles. Dispersal corridors would consist of areas of continuous or nearly continuous canopy cover.
16. Implement landscape management controls in the matrix to provide for spotted owl dispersal. Adopt a standard guidance which would assure that spotted owl dispersal habitat is provided. In past management plans, the "50-11-40 rule" has been the guidance to meet this need. Prior to timber harvest the planning area under consideration would be analyzed to determine whether the landscape provides for owl dispersal. The mitigation would restrict harvest in those areas until they met 50-11-40.

**Other Measures**

17. Remove inventoried roadless areas (RARE II) from the suitable timber base. This mitigation measure would apply to those portions of inventoried roadless areas that still would qualify under the criteria used for the original inventory.
18. Retain all old-growth forests in Marbled Murrelet Zone 1, including Adaptive Management Areas. Residual stands of old-growth forest which occur in the matrix and Adaptive Management Areas in Marbled Murrelet Zone 1 would be retained. The intent of the mitigation would be to protect all potential marbled murrelet nesting habitat in the area most important to this species.
19. Provide for retention of old-growth fragments in watersheds where little remains. This mitigation measure was specifically designed to benefit many species of fungi, lichens, bryophytes, arthropods, and vascular plants, and would likely also benefit vertebrate species such as small mammals and amphibians, and various bird species. Landscape areas where little late-successional forest persists would be managed to retain late-successional patches. This mitigation would be applied in fifth field watersheds (20 to 200 square miles) which are currently comprised of 15 percent or less late-successional forest, accounting for all allocations in the watershed. Within such an area, all relict late-successional stands would be protected. In areas containing significant non-federal land, or in Adaptive Management Areas, this mitigation would be treated as a threshold for analysis rather than a strict standard and guideline.
20. Provide residual habitat areas around known spotted owl activity centers. The mitigation measure would apply to northern spotted owl activity centers that are not protected by Congressional Reserves, Late-Successional Reserves, Riparian Reserves, Managed Late-Successional Areas, or Administratively Withdrawn Areas. One hundred acres of the best northern spotted owl habitat would be retained as close to the nest site or owl activity center as possible for all known spotted owl activity centers in the matrix and Adaptive Management Areas. This would be intended to preserve an intensively used portion of the breeding season home range. "Activity center" is defined as an area of concentrated activity of either a pair of spotted owls or a territorial single owl.
21. Protect sites from grazing. This mitigation measure is designed to benefit specific mollusks, arthropods, and vascular plants (see species reports). Known and newly discovered sites of these species would be protected from grazing as needed to ensure that the local populations of the species would not be impacted
22. Manage impacts in recreation areas to minimize disturbance to species. This mitigation measure would benefit a number of fungi and lichen species whose known locations are

predominantly within established recreation sites. The mitigation activities would be site-specific.

23. Identify species-specific measures. This category would include additional site-specific mitigation measures that would be implemented to provide for sites under the "survey and manage" mitigation component. Such measures have been identified for some of the mollusk, fungi, and lichen species. The specific measures would include protection from fire, prohibition of commercial harvesting, and protection from water impoundments and spring diversions.

## Step 6: Describe the Benefit Provided to Each Species and/or Species Group by Each Mitigation

The final step in the process was to describe and display the level of benefit provided to each species by each of the possible mitigation measures. This involved reviewing the effect of all 23 consolidated mitigation measures on each species or group of species. The level of benefit that a mitigation measure would provide to a species was described, and these eight levels of benefit are displayed in Table J2-3. The results of this assessment for all species are shown in Tables J2-8a through J2-8k.

Table J2-3. Categories used to summarize the benefit that would be provided to each species by each possible mitigation measure. These numbers correspond to the numbers in Tables J2-8a to J2-8k.

1. It is judged that this mitigation measure would bring the species to the point where it would pass all the initial screens.

2. This mitigation measure, in combination with another measure, would bring the species to the point where it would pass all the initial screens.

3. While this mitigation measure would be beneficial, the species is still likely to fail a screen based on federal habitat management. The species would be more fully protected by another mitigation.

4. While this mitigation measure would be beneficial, the species is still likely to fail a screen based on federal habitat management. Adoption of another alternative is the only mitigation that would be fully successful to pass screens.

5. While this mitigation measure would be beneficial, the species is still likely to fail a screen based on federal habitat management, and no other alternative or mitigation would bring it to the point where it would pass the screen.

(Table J2-3. continued)

6. While this mitigation measure would be beneficial, the species is still likely to fail a screen due to influences outside the scope of this decision.
7. Mitigation would do harm to the species.

Cells that are shown as blank in the tables indicate that the mitigation measure is not applicable to the species, or is not one of the primary mitigation measures for the species, or that its effects on the species are unknown.

## Summary of Findings for Each Species Group

### A. Bryophytes

Overall, Alternative 9 affords fairly high protection to bryophytes. Eight bryophytes (two mosses and six liverworts) failed to pass the screens and received additional analysis. Two of these species (*Antitrichia curtipendula, Douinia ovata*) passed the first screen but were considered due to concerns regarding cumulative effects. One of the species (*Ptilidium californicum*) was reevaluated due to the proposed shortening of the harvest rotation length in California. Based on additional analysis, one species that failed the screen (*Thamnobryum neckeroides*) was found to occur in hardwood thickets, seepage areas, and talus slopes adjacent to but not in stands of old-growth . It was therefore considered not to be closely associated with late-successional and old-growth forests, although it would benefit from additional riparian protection.

For three species that failed to pass the screens (*Tritomaria exsectiformis, Marsupella emarginata* var. *aquatica*, and *Diplophyllum plicatum*), ratings were not higher in any other alternative and no mitigation measure would bring them to the point where they would pass the screens. However, several mitigation measures would benefit these three species. *Marsupella emarginata* var. *aquatica* would benefit from protection of the only site from which it is known, and which receives heavy recreational use. *Tritomaria exsectiformis* would benefit from fencing to protect known populations from livestock and recreationists. Conducting additional surveys and managing newly-discovered sites would also improve the outcome for these two species. *Diplophyllum plicatum* would benefit from measures that provide for coarse woody debris in the matrix.

Maintaining long rotations (180 years or more) in high elevation white fir forests in California was considered important for *Ptilidium californicum*. However, a combination of other measures would successfully mitigate this species. These measures would include protection of known sites, provisions for coarse woody debris and green tree retention in the matrix, provisions to retain old-growth fragments, provisions to provide 100-acre habitat areas around spotted owl activity centers, and conducting additional inventories and protecting known sites may be sufficient to raise the ratings to the point where this species would pass the screens. This species is also addressed in Mitigation Step 5 in the Scientific Analysis Team Report.

The other four species that were subject to additional analysis can be successfully mitigated. *Antitrichia curtipendula* and *Douinia ovata* would be successfully mitigated by implementation of Riparian Reserve Scenario 1. *Kurzia makinoana* would be successfully mitigated by a combination of Riparian Reserve Scenario 1, provisions for coarse woody debris and green tree leave, and provisions to retain old-growth fragments in watersheds where little remains. *Scouleria marginata* would be successfully mitigated by Riparian Reserve Scenario 1, and additional provisions for riparian management in Adaptive Management Areas.

If the proposed mitigation measures are not implemented, several species could be extirpated from portions of their ranges. *Ptilidium californicum* may be extirpated from the southern portion of its range in northern California. *Marsupella emarginata var. aquatica* could also be subject to extirpation. Although additional species locations may be found, protection of the only known site should be considered a high priority.

Loss of bryophyte species could influence the function of ecosystems in a variety of ways. For example, *Antitrichia curtipendula* plays a "keystone" role in mineral cycling and regulation of microclimate in the canopy. It also provides nesting sites for the marbled murrelet and red tree vole. Loss of this species or other key species of bryophytes could disrupt aspects of ecosystem function.

It is estimated that $100,000 would be necessary to conduct inventories necessary for mitigation for this group, in addition to field surveys conducted during watershed analysis. While the bryophyte flora of the Pacific Northwest has generally been well studied, additional surveys could result in the discovery of additional undescribed taxa or identification of range extensions.

## B. Fungi

In the FEMAT report, 527 species of fungi were evaluated that were determined to be closely associated with late-successional forest ecosystems. This list of species represents only a small percentage of the macrofungi that occur in late-successional forests. If microfungi were included, the list would be greatly expanded. For every group of fungi, there are many species, perhaps hundreds, in addition to those on the original list (see FEMAT Report, Table IV-A-1).

## Screens

Two hundred and thirty-nine species of fungi failed to pass the four screens and were reassessed. Two hundred and fourteen of these species failed to pass the first screen, the original Assessment Team rating in the FEMAT Report for Alternative 9. In general, the ratings in the FEMAT Report corresponded with acreages and distribution of late-successional forests and management in the matrix. Sixteen species were added which failed the cumulative effects screen. One species was analyzed because of changes to Alternative 9. There were at least five other species for which the change from the 180-year rotation in California caused concerns, but they also failed the FEMAT or cumulative effects screens. Another eight species were reanalyzed with additional information not available at the time of the original rating; five of these species do not require mitigation. Fifteen species from the original FEMAT list were removed from the list based on additional information which indicated those species did not meet the criteria of being closely associated with old-growth forests. The species that were reanalyzed represent the broad spectrum of fungi that occur in late-successional forest ecosystems, including mycorrhizal, saprobic and parasitic species.

### FEMAT Rating Screen

Of the 214 species which failed to pass the first screen (Assessment Team ratings in the FEMAT Report), over half were rare and/or locally endemic fungi. For many of these species, the ratings reflect inherent life history characteristics and rarity more than features of the alternative. These 129 species are known from only one or a few sites. Eighty of these species are endemic to the Pacific Northwest, and their extirpation from known locations could potentially cause extinction of the species. In addition, many of these sites represent the type localities from which the original material was collected for describing the species. Cumulative effects on nonfederal land was the primary concern for fourteen of the rare species.

Another reason some species failed to pass the first screen (Assessment Team rating) was the lack of well-distributed old growth at the scale considered necessary for fungi. Past forestry management practices, land ownership patterns and fire history have resulted in a shortage of old-growth forests in certain watersheds, landscape areas and geographic localities. Areas of particular concern are coastal and low elevation forests; especially limited is old growth within the Sitka spruce zone. Of 23 species that showed a strong association with these forests, 16 are rare and/or endemic.

The importance of remnant old-growth stands for many groups of fungi is reflected in the differences in the likelihood of Outcome C and D under Alternative 1 compared to Alternative 9. The retention of old-growth fragments (LS/OG3s) in Alternative 1 resulted in improved outcomes for 97 species. In general, these are the more widely distributed but uncommon species, although the distribution and range of individual species is not well known. The protection of LS/OG3s in watersheds where older stands are deficient would contribute to a well-distributed network of old growth in the near term. Even small stands would improve the outcome for these 97 species. In many cases, these old-growth stands function as refugia where fungi and many other species may persist until suitable habitat conditions become available in adjacent stands. These stands are particularly important for species with limited dispersal capabilities. While the entire LS/OG3 network would provide maximum protection for these species, substantial benefit may be achieved by addressing retention of LS/OG3s on a watershed level.

Riparian Reserve Scenario 1 was responsible for higher ratings in Alternatives 1 and 4 for two species which failed the FEMAT screen for Alternative 9. These species show a strong preference for habitats associated with seeps and intermittent streams. There are likely many riparian fungus species that will benefit from the Riparian Reserves, although the fungi which inhabit riparian zones were not the focus of the original FEMAT Report analysis.

Management of the matrix was an important consideration in the original Assessment Team ratings in the FEMAT Report, and was another reason why some species did not pass the screen for Alternative 9. Many late-successional and old-growth associated fungi benefit from (if not require) the biological legacies that persist from old-growth stands, including coarse woody debris, habitat structures, and host species. Mycorrhizal fungi require live hosts, including conifers and many species of vascular plants, which in turn depend on the fungi for uptake of nutrients and water. Biological legacies are also important for saprobic and parasitic species of fungi. Many species of fungi require the microclimate that is provided by old-growth stands. Coarse woody debris is an important substrate for many fungi. The short rotation scenario in the matrix (80-120 years) will not provide an adequate renewable supply of large down logs over successive rotations. Forest management may have positive effects such as increasing the sustainability of fungal diversity within managed stands. This could be accomplished by management strategies that would provide for an increase in the diversity of structure and age-class distribution, a diversity of host species, as well as providing for larger logs and snags.

For many of the fungi, specific distribution patterns across the landscape are not well known. Of particular importance is whether or not populations fall within land allocations designated as Late-Successional Reserves or matrix. Providing some carryover of old-growth stands in the matrix would increase the likelihood of maintaining species while additional knowledge is gained on the distribution of individual species and populations, as well as the role of these species in forest succession and ecosystem function.

The limited available knowledge for some species or groups of fungi was a factor in the original ratings. For some fungi, lack of information on specific habitat requirements, geographic distributions and ranges, and locations of populations relative to proposed land allocations in Alternative 9 resulted in conservative ratings. Little is known about how the species composition of fungi changes over time during forest succession, and the relationships among species that occur in young, mature, and old stands.

### Cumulative Effects Screen

Sixteen species of fungi were reassessed solely because they failed to pass the cumulative effects screen, although cumulative effects is a concern for many of the species considered in this analysis. Important factors contributing to cumulative effects include land ownership patterns and management practices which result in loss of extensive areas of habitat for late-successional fungi. Particular areas of concern are the coastal and low elevation forests where nonfederal lands play a key role, and where there is a shortage of older age classes on federal land.

Commercial harvest of fungi has greatly increased in recent years, creating potential impacts on species populations and habitats. Harvest of fungi may affect species viability by potentially decreasing distribution, frequency, reproduction and productivity, as well as genetic variability of species. Currently, most of the species that are commercially harvested are not considered at risk, but future impacts may affect their viability.

Deteriorating air quality may result in a decrease in species viability. Evidence from European forests shows a decline of fungal diversity and abundance. Intensive forestry management practices, air pollution and harvest of fungi are factors implicated in this decline. Global climate change could affect distributions of species populations.

Frequency and intensity of treatment, including recreational impacts, is another important factor in cumulative effects analysis. Site treatments that disrupt the soil and litter layer will have a detrimental effect on populations of fungi, and may alter the role of decaying wood in the nutrient-cycling process. Trampling, compacting the soil and litter layer, removing woody debris for firewood or other reasons, or inadvertently introducing non-native species could impact fungal populations, particularly the rare species. Forest management practices and site treatments in early-successional stands could also influence the occurrence and diversity of species in late-successional forests.

### Changes to Alternative 9 Screen

The change from the 180-year rotation in northern California was of concern for *Phytoconis ericetorum*, the mushroom lichen, that reaches the southern limit of its distribution in California. Shortened rotations may threaten local populations of this already uncommon species in this area. Persistence of the species in the matrix may depend on management of leave trees and large coarse woody debris. The change from the 180-year rotation was also of concern for five other species.

## Primary Mitigation Measures

### Survey and Manage Individual Sites

The survey and manage mitigation measure would apply at various levels to all fungus species that were reanalyzed. Levels of survey and general schedules for that survey are displayed in Appendix B11. The most immediate application of the mitigation would be to the 147 fungus species that are considered very rare and/or locally endemic or which have their type localities within the FEMAT area. These species are listed under survey strategy 1 in Appendix B11.

For rare or locally endemic species, or those with type localities in the FEMAT area, this mitigation would call for management of known sites and subsequent inventories for species and management of newly-discovered sites. Management of known sites of rare and locally endemic species could include designation as Special Interest Areas or Areas of Critical Environmental Concern. Management standards and guidelines would be developed that would protect the population from adverse impacts. In particular, all type localities would be managed for the continued viability of the species. These type localities are an important resource and represent the site where the original material for describing the species was collected. Location and distribution for all the rare or locally endemic taxa would be documented and maintained in a Geographic Information System (GIS) data base.

Of particular concern are the sites where *Oxyporus nobilissimus* occurs. The "Fuzzy Sandoze" is an extremely rare and endemic polypore, and may be petitioned for federal listing under the Endangered Species Act. Live specimens are known only from six localities, ranging from Linn County, Oregon north to the Snoqualmie River valley in the Washington Cascades, and the East Fork of the Humptulips River on the Olympic Peninsula. This species is closely associated with old-growth and late-successional forest structures, and usually occurs with noble fir. In the Olympics it is associated with silver fir. It appears to require very large diameter trees, snags and stumps, but has never been observed on logs. Fruiting bodies are perennial and quite large, therefore this species is relatively easy to survey. Protection of the known populations would decrease the risk of extirpation or extinction. Under this mitigation measure, protection zones of a square mile would be established for known species location that are not otherwise protected. Only two of the localities occur outside of protected areas, so an estimated 1,200 acres is needed for protection of these populations.

Many sites of these rare taxa are known, however literature or herbarium research is needed to identify some localities. As noted in the individual species write-ups, at least 30 rare species have populations within areas that are already protected. These areas may merit designation as Special Interest Areas or Areas of Critical Environmental Concern, and the development of management guidelines to protect the rare species. Under this mitigation, type localities for at least 17 of the rare and/or endemic and/or type locality species not otherwise protected would be temporarily protected from ground-disturbing activities pending site evaluation and population inventory. These species are identified in the individual species write-ups. An area of 160 acres would be temporarily protected pending ground inventory of the habitats and local area. This could amount to an estimated total of 2,500 acres to protect these type localities for rare species. The objective of the ground inventory would be to survey for the species and manage individual sites where they occur. Surveys would aid in identification of habitat requirements and distribution of the population. It is unknown how much habitat for the target species exists on any given site. Final decision on the areas to be managed for protection of the species should be made in consultation with professional mycologists.

For the remainder of the 147 species, the area to be protected would be determined on a site-specific basis. Additional surveys around the known locations would be a high priority for these species.

As more information is acquired, additional sites for rare and endemic taxa may need protection. However, additional information could also reveal that species considered rare are actually more widespread or common. If the need no longer exists, areas being protected for these species may be returned to other allocations.

Fourteen of the rare species face an uncertain future because their continued existence likely depends on management activities and land use of non-federal land. Federal lands in the vicinity of these localities should be surveyed, targeting the habitat of the species, and an attempt should be made to protect locations of the species. Federal agencies should work with state and private landowners to protect known locations of species of concern and associated habitats.

In addition to protection of sites for individual species, areas which support a diversity of species and concentration of rare and/or endemic fungi could be established as Special Interest Areas or Areas of Critical Environmental Concern to identify the important mycological resource values of the site. Several areas are recommended based on current knowledge: Cascade Head Botanical Area and Experimental Forest, Siuslaw National Forest; Deadfall Meadows, Klamath National Forest; Lamb Butte Scenic Area/Olallie Ridge Research Natural Area, Willamette National Forest; Marys Peak Recreational and Botanical Interest Area, Siuslaw National Forest; Little Sink Area of Critical Environmental Concern/Research Natural Area, Salem District, Bureau of Land Management.

In addition to the 147 rare and endemic species, some level of inventory and site management is recommended for all fungus species that were reanalyzed. The current distribution of all fungus species is poorly known. We do not know where all populations of species occur, the specifics of their habitat requirements, interactions among species, and the successional role of fungus species in different stands or habitats. Of particular importance is the distribution of populations of fungi relative to the land allocations proposed in Alternative 9. This information would be helpful in identifying standards and guidelines for future management that will help increase or maintain fungal species diversity, especially in the matrix.

The resulting strategy for fungi survey is two-tiered, with the first priority to identify the known locations of the rare and endemic fungi, including type localities. Additional survey would be conducted in the areas around these locations. This effort would take about three years, with an estimated cost of $1 million. The next level of the survey is to establish a regional mycological inventory to develop knowledge, expertise and a database with associated GIS layer for Pacific Northwest fungi, modeled after the Region 6 Ecology Program. The objective of this survey is to develop information on species distributions, habitat/plant associations, successional relationships, and species abundance throughout the region. Species of fungi are also important as indicators of forest and ecosystem health. A regional network of permanent plots will provide valuable baseline data which can be used for monitoring.

This effort should be funded and sustained for at least 10 years in order to accomplish the objectives, with an estimated cost of $10 million over a ten-year period. Three geographic focal points are recommended to cover the region of Washington, Oregon and California. This would be an efficient way to develop specialized expertise for each state and to minimize travel. A senior mycologist at each center would direct the program, and be assisted by two professionals, seasonal field crews and technicians. Volunteer assistance could be incorporated from local mycological societies and interested amateurs. The field sampling and collecting would occur during the fruiting season, a period of about 5-6 months per year.

There are some difficulties associated with surveying for organisms with ephemeral fruiting bodies. Many fungi do not fruit every year, and species have their particular season of reproductive activity.

It is likely that undiscovered populations of species will occur. Species which are currently thought to be rare or more restricted in their range may actually turn out to be more widespread or abundant. As more information is developed, it will be possible to manage our natural resources more effectively.

A substantial cost is associated with field work, and this survey could be expanded to incorporate other at risk organisms such as lichens and bryophytes. It is probably more cost effective to conduct a complete ecological inventory than focusing on species-specific surveys.

### Provide for a Well-Distributed Network of Old-Growth Forests Across the Landscape

Historical events and management practices have resulted in a shortage of old-growth forests in certain localities. Areas of particular concern are coastal and low elevation forests; especially limited is old growth within the Sitka spruce zone. Patches of old growth distributed across the matrix are important refugia for late-successional fungi, as well as a source of inoculum for dispersal into adjacent stands. Proposed mitigation measures that would accomplish this objective are:

**Mitigation Measure 17** - Remove inventoried roadless areas from the suitable timber base. Forty-four species of fungi would benefit from this measure, although the specific benefits could not be quantified in the time provided. The species potentially benefited by this mitigation would be those that occur at high elevation. Specific locations of roadless areas relative to the distribution of species populations could be identified to allow this mitigation to be applied in a more site-specific way.

**Mitigation Measure 18** - Retain all old-growth forests in Marbled Murrelet Zone 1, including Adaptive Management Areas. This mitigation would benefit 155 species of fungi with coastal or low elevation distributions. In many cases, these old-growth stands function as refugia where fungi and many other species may persist until suitable habitat conditions become available in adjacent stands. These stands are particularly important for species with limited dispersal capabilities. Of specific concern is the availability of old growth in the Sitka spruce zone. Twenty-three species showed strong association for these spruce stands, or other stands along the coast.

**Mitigation Measure 19** - Retain old-growth fragments in watersheds where little remains. This measure would benefit 218 species of fungi. This concept is general in nature, and it is likely that all species that occur in these stands will benefit. These isolated remnants are ecologically significant because they function as refugia for a host of old-growth associated species, and are important for those with limited dispersal capabilities.

**Mitigation Measure 20** - Provide residual habitat areas around known spotted owl activity centers. This measure would benefit 153 species, primarily those species with lower elevation distributions. Again, this mitigation would help provide for a well-distributed old-growth network, and would benefit all species located in those stands.

## Provide for Additional Habitat Elements in Matrix Management

Matrix management is an important consideration in providing for late-successional and old-growth associated fungi. These species would benefit from coarse woody debris, habitat structures, microclimate, and host species retained from the original stand. Specific matrix management provisions which provide for retention of biological legacies from the original stand would reduce risk of extirpation for these fungi.

**Mitigation Measure 11** - Provide specified amounts of coarse woody debris in matrix management. This measure would benefit 230 species. Coarse woody debris is an important substrate for many fungi as well as other organisms such as mosses, liverworts, arthropods and amphibians. The objective is to provide this substrate well-distributed across the landscape in a manner which replicates the quantity, quality (such as species and size distribution), and distribution of down logs that would occur in natural, unmanaged stands. Significant quantities of logs are important, as well as a distribution of decay classes. Most species of fungi that were reassessed would benefit from this mitigation, as well as the hundreds of other fungi and organisms that rely on this substrate for habitat. The down logs need to occur in the microclimate provided by the canopy of a forest patch to provide for the fungal species that occupy this substrate. Short rotations (80-120 years) would not provide an adequate renewable supply of large down logs over successive rotations. This possible effect could be mitigated by retaining clumps of green trees in harvest areas and by assuring that the landscape contain suitable proportions of young and old forests.

**Mitigation Measure 12** - Emphasize clumped green tree and snag retention in matrix management. This measure would benefit 230 species of fungi reassessed in this analysis. These patches should include not only the biggest and oldest trees, but a diversity of tree sizes, species and ages within a patch. It is important to maintain the microclimate associated with this patch to provide the most benefit to fungi. Retained patches should be protected for multiple rotations so they provide habitat for those organisms which require older forests, in addition to providing habitat connectivity through time.

**Mitigation Measure 13** - Modify site treatments, particularly the use of fire and pesticides, and minimize soil and litter disturbance. This measure would benefit 227 species of fungi that were reassessed, although many additional species would benefit from reducing the amount of site disturbance. Yarding and heavy equipment, hot burns for site preparation, removal of humus layers and coarse woody debris, and soil compaction could reduce the viability of certain fungus species. The intensity and frequency of disturbance are important factors to consider in site treatments.

## Other Miscellaneous Measures

**Mitigation Measure 22** - Manage recreation sites to minimize disturbance. This measure would benefit 45 species of fungi which are known to occur in recreational areas. Most of these are rare and locally endemic fungi, and this measure would help reduce the risk of extirpation of these species.

**Mitigation Measure 23** - Other mitigation measures which could be applied in specific instances for the benefit of certain species include protecting type localities from fire;

monitoring commercial harvest and possibly developing regulations to provide for sustainable production of species populations; and lengthening rotations in specific areas of California to address species concerns. Fourteen species are identified in this category, and may also be addressed in conjunction with Mitigation measure 1 which provides for surveys to acquire additional information and ascertain levels of protection.

### Riparian Reserves

**Mitigation Measure 5** - Apply Riparian Reserve Scenario 1 to all intermittent streams throughout the range of the northern spotted owl. This measure would directly benefit 7 species of fungi that occupy riparian habitats, and another 16 species that occupy moist habitats. This measure would also benefit many more species not identified here.

## Limitations of Mitigation Measures

Even if all mitigations were implemented, there would still be some risk of extirpation, particularly for the rare and endemic species. This would be particularly true for 14 species for which cumulative effects would remain a concern. These include species of rare false truffles, rare truffles, undescribed taxa of rare truffles and rare false truffles, rare zygomycetes, rare cup fungi, and parasitic fungi.

# C. Lichens

## Introduction

All 16 groups of lichens, representing 136 species, failed to pass the first screen based on the original Assessment Team ratings in the FEMAT Report. However, 5 groups (57 species; 42 percent) failed due to a low number of likelihood points in Outcome D (restriction to refugia). This rating may have reflected general uncertainty regarding the future of these species. Groups that received less than 3 likelihood points in Outcome D were not evaluated further if the total points in C and D were less than 20.

In order to better reflect specific information that was available, species were analyzed separately, rather than in the groups addressed in the FEMAT Report (Table IV-18). Seventy-five species of lichens failed to pass the (modified) FEMAT screen and received additional analysis. In general, the primary factors that affected the Assessment Team ratings in the FEMAT Report were acreage of Late-Successional Reserves, stand treatment within the Matrix, and protection of riparian corridors (FEMAT, IV-95). Aquatic and riparian lichens rated higher in alternatives with greater riparian protection.

No additional species were evaluated based only on cumulative effects concerns. However, the potential for cumulative effects was reviewed for all species. For lichens, the primary cumulative effects concerns are related to deteriorating air quality because lichens are very sensitive to air pollution, collection of lichens as special forest products (and incidentally during moss harvest), and activities on nonfederal lands.

## Primary Mitigation Measures

The primary mitigation measures identified as benefiting lichens were prescriptions for green-tree retention in the matrix, inventory and management of sites, and provision of a well-distributed network of late-successional and old-growth stands throughout the landscape. Riparian Reserve Scenario 1 on intermittent streams would benefit the riparian and aquatic species, although this measure may not be required to raise the ratings if site-specific mitigations are implemented where species are considered at risk. Implementing the proposed mitigation measures would increase the ratings for nitrogen-fixing lichens, riparian and aquatic lichens, and may increase the ratings for all other groups. The extremely slow growth rates and long periods required for certain late-successional and old-growth associated lichens to colonize stands emphasizes the considerable importance to these species of existing old stands and old trees within younger stands.

### Survey and Manage Individual Sites

Survey and management of individual sites is recommended to maintain habitat for the rare and/or locally endemic species. This mitigation would be particularly beneficial to the 16 species of oceanic lichens because they are known to be fairly narrowly restricted along the coast within sight of the ocean. Specific sites would be evaluated and prioritized for management to protect these species. Designation of Special Interest Areas or Areas of Critical Environmental Concern could be appropriate measures for sites where lichens are found. Three aquatic lichens require clear water; therefore, evaluation of upstream management and sediment loads may be necessary. Known locations of rare rock lichens would be managed to maintain their habitat under this mitigation.

Surveying for many of the other more widely-distributed species is somewhat problematic. In general, the nitrogen-fixing lichens will be difficult to survey due to the position they occupy in the forest canopy. Many of these species do not enter stands until the stand reaches 150-200 years. These species often occupy the large, lateral branches within the canopy. These are fairly stable substrates, and it is uncommon for these large branches to break off and fall to the forest floor. For many of these species, the only way to verify their presence is to sample the canopy, which is logistically difficult and expensive. While it is not feasible to apply the survey and manage measure widely for these species, it may be necessary to survey specific sites or potential habitats of rare species. Site-specific treatments need to be developed that would protect the integrity of the habitat and provide for these rare species, since they are at a much higher risk of extirpation.

The cost of surveys recommended as mitigation measures for lichens that did not pass the screens is estimated at $500,000. Initially, surveys would focus on the vicinity of known locations of populations of rare or endemic species. These populations are important to manage in order to prevent their extirpation. Other surveys would be accomplished as part of watershed analysis to determine species diversity and abundance of species within geographic areas, successional stages and habitats. It would be efficient to incorporate lichen surveys into a regionwide ecological inventory such as is proposed for the fungi. It is more cost effective to sample for various species at the same time. The benefit of this level of survey is the generation of more information on the distribution, abundance and habitat preferences of lichen species.

### Matrix Management Provisions

Emphasis on clumped green tree and snag retention in the matrix could benefit 58 species of lichens which were analyzed. Clumping the leave trees would moderate climatic factors and provide a variety of microclimates that contribute to the survival of many lichen species, as well as provide additional habitat for dispersal. Lichens may be limited in their dispersal capabilities, and are slow to recolonize stands; therefore, patches of leave trees function as refugia where these old-growth associated species can persist until conditions become suitable for their establishment in the developing stand.

The selection of specific trees to retain is an important component of this mitigation measure. To the extent possible, the biggest, oldest trees with the most diverse structural characteristics would be retained. This would provide for a diversity of microhabitats and associated species diversity. Trees that have an abundant epiphytic flora should be favored when selecting the leave trees, because they provide a source of genetic material and propagules for a greater number of species. Selecting for heterogeneity may enhance biological diversity across the landscape for this group of organisms. Leaning trees are important for the pin lichens because of the difference in stem flow or exposure on various parts of the tree. These retained patches would be protected for multiple rotations to provide habitat for these organisms which require older forests, and to provide for habitat connectivity through time. This becomes particularly important for the nitrogen-fixing lichens due to their slow colonization and growth rate.

Modifying site treatment practices, particularly limiting broadcast and slash burning and the use of herbicides, would benefit most species of lichens, and was specifically addressed for the 20 nitrogen-fixing species.

### Provide for a Well-Distributed Network of Old-Growth Forests Across the Landscape

Older stands that are well-distributed geographically would improve the likelihood of survival and persistence of lichens in the ecosystem. Many old-growth forest lichen species require the ecological continuity of old stands in order to persist. These stands are important refugia, particularly for lichens that have limited dispersal capabilities. Historic events and management practices have resulted in a shortage of late-successional and old-growth stands in certain areas. Areas where late-successional and old-growth stands are particularly scarce are the coastal and low elevation forests. It would benefit lichens to retain what remains of these older stands in geographic areas or watersheds where it is limited, and to identify replacement stands which would be allowed to develop into old-growth where there is, or is anticipated to be, a shortage of this age class in the landscape.Low elevation stands may be particularly important for the nitrogen-fixing species, which generally occur at elevations below 3,000 feet.

The mitigation measures that would provide for a well-distributed network of late-successional and old-growth stands across the landscape include: retaining all old-growth forests within Marbled Murrelet Zone 1, providing for retention of old-growth fragments in watersheds where little remains, providing for residual habitat areas around known spotted owl activity centers, and removing the inventoried roadless areas and Tier 1 Key Watersheds from the suitable timber base. These mitigation measures would benefit 61 lichen species that were addressed in this analysis.

### Riparian Reserves

Riparian Reserve Scenario 1 would benefit three species of aquatic lichens, and nine species of riparian lichens. These species could also be mitigated by site-specific measures directed at species populations and maintaining the integrity of habitat where known populations occur.

### Other Miscellaneous Measures

Managing recreation areas to minimize disturbance to species was identified as an important mitigation for the oceanic lichen species. Applying this mitigation measure would benefit 16 species of lichens, 3 of which are endemic. These species occur in close proximity to the ocean, and recreation and development could potentially impact their populations.

An air quality monitoring program could be initiated across the region using lichens as biological indicators of air quality. Nitrogen-fixing lichens are negatively affected by air pollution and are especially sensitive to sulfur dioxide. This monitoring is important in order to establish baseline conditions, to document future trends, and to monitor changes in forest health.

## Limitations of Mitigation Measures

Even if all mitigation measures were implemented, there would still be risk of extirpation, particularly for the rare and endemic species. However, this risk would be substantially reduced by implementation of the mitigation measures. Some risk may remain due to cumulative effects. For example, deteriorating air quality may result in local or widespread extirpation of lichen species. This has already been documented in many parts of Europe and eastern North America.

# D. Vascular Plants

Seventeen vascular plant species were reanalyzed in all or portions of their ranges. All species that failed the screens were either rare within the range considered or locally endemic. Five species were narrowly endemic with known distributions spanning one to four National Forests (*Aster vialis, Clintonia andrewsiana, Corydalis aquae-gelidae, Pedicularis howellii*, and *Scoliopus bigelovii*); of these, two are federal candidate species (*Aster vialis, Corydalis aquae-gelidae*). All others are considered rare either throughout their entire range or within the planning area. Six species (*Arceuthobium tsugense, Botrychium minganense, Coptis trifolia, Cypripedium montanum, Galium kamtschaticum*, and *Habenaria orbiculata*) have ranges that extend beyond the planning area and may be more common in other portions of their range.

Three species failed due primarily to concerns regarding cumulative effects (*Bensoniella oregona, Clintonia andrewsiana*, and *Scoliopus bigelovii*).

# Matrices of Benefits From Mitigation Measures for Each Species Group

## Introduction

This portion of Appendix J2 represents the results of Step 6: Describe the Benefit Provided to Each Species and/or Species Group by Each Mitigation, as described in more detail earlier in this appendix under Description of the Process.

The objective of this final step in the process was to describe and display the level of benefit provided to each species by each of the possible mitigation measures. This involved reviewing the effect of all 23 consolidated mitigation measures on each species or group of species. Results of this review are displayed in the following tables. The columns represent the 23 mitigation measures, which are listed below. More detail on the specific measures is presented in the section on Methods of Additional Species Analysis in the Final SEIS.

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### Survey and manage

1. Survey to acquire additional information and ascertain levels of protection
2. Survey for the species and manage individual sites where it is found
3. Manage currently known locations of the species
4. Survey for the species, and apply Riparian Reserve Scenario I guidelines along intermittent streams and small headwaters where the species is found

### Riparian Reserves

5. Apply Riparian Reserve Scenario I on intermittent streams with anadromous salmon or trout throughout the range of the owl
6. Apply Riparian Reserve Scenario I on intermittent streams with anadromous salmon or trout throughout the range of coho salmon
7. Ensure that riparian management in Adaptive Management Areas provides species protection equivalent to riparian reserves
8. Apply Riparian Reserve Scenario I to ponds and other open water bodies less than 1 acre

### Key Watershed Protection

9. Apply greater protection to Tier 1 Key Watersheds by removing them from the suitable timber base
10. Build no new roads in Tier 1 Key Watersheds

### Matrix Management Provisions

11. Provide specified amounts of coarse woody debris in matrix management
12. Emphasize clumped green tree and snag leave in matrix management

13. Provide additional no-harvest buffers around cave entrances
14. Modify site treatment practices, particularly the use of fire and pesticides, and modify harvest methods to minimize soil and litter disturbance
15. Provide dispersal corridors where needed in the range of red tree voles
16. Implement landscape management controls in the matrix to provide for spotted owl dispersal

**Miscellaneous Measures With Significant Impact**

17. Remove inventoried roadless areas from the suitable timber base
18. Retain all old-growth forests in marbled murrelet zone 1, including Adaptive Management Areas

**Other Miscellaneous Measures**

19. Provide for retention of old-growth fragments in watersheds where little remains
20. Provide residual habitat areas around spotted owl activity centers
21. Protect sites from grazing
22. Manage recreation areas to minimize disturbance to species
23. Other

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The entries in the tables indicate the level of benefit provided to each species or species group by each mitigation measure. The following categories were used to summarize the benefits. The numbers that appear in the cells in the following tables are based on these categories.

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1. It is judged that this mitigation would bring the species to the point where it would pass all the initial screens.
2. This mitigation, in combination with another mitigation, would bring the species to the point where it would pass all the initial screens.
3. This mitigation would be beneficial to the species, but it is still likely to fail a screen based on federal habitat management. The species would be more fully protected by another mitigation.
4. This mitigation would be beneficial to the species, but it is still likely to fail a screen based on federal habitat management. Adoption of another alternative is the only mitigation that would be fully successful to pass screens.
5. This mitigation would be beneficial to the species, but it is still likely to fail a screen, and no other alternative or mitigation would bring it to the point where it would pass the screen.
6. This mitigation would benefit the species, but it is still likely to fail a screen due to influences outside the scope of this decision.
7. Mitigation would do harm to the species.

If the cell is left blank, it indicates that mitigation is not applicable to the species, or the measure is not one of the primary mitigations for the species, or the effects of the measure on the species are unknown.

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**Table J2-8a Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **BRYOPHYTES** | | | | | | | | | | | | | | | | | | | | | | | |
| **Individual Species** | | | | | | | | | | | | | | | | | | | | | | | |
| Antitrichia curtipendula | | | | | 1 | 1 | 3 | | | | | | | | | | | 3 | 2 | 2 | | | |
| Diplophyllum plicatum | 5 | | 6 | | | | | | | | 6 | | | | | | | 6 | | | | | |
| Douinia ovata | | | | | 1 | 1 | 3 | | | | | | | | | | | 3 | 2 | 2 | | | |
| Kurzia makinoana | 2 | | | | 2 | 2 | 2 | 2 | | | 2 | 2 | | | | | | 3 | 2 | | | | |
| Marsupella emarginata var. aquatica | | 5 | 3 | | | | | | | | | | | | | | | | | | | 5 | |
| Ptilidium californicum | 2 | 2 | | | | | | | | | 2 | 2 | | | | | | | 2 | 2 | | | |
| Scouleria marginata | 2 | | | | 2 | 2 | 2 | | | | | | | | | | | | | | | | |
| Tritomaria exsectiformis | | 3 | | | 5 | | | | | | | | | | | | | | | | 3 | 5 | |

**Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Boletes** | | | | | | | | | | | | | | | | | | | | | | | |
| Gastroboletus subalpinus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Gastroboletus turbinatus | | 2 | 2 | | | | | | | | 3 | 3 | | 2 | | | | 2 | 3 | 3 | | 3 | |
| **Chanterelles - Gomphus** | | | | | | | | | | | | | | | | | | | | | | | |
| Gomphus bonarii | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | |
| Gomphus clavatus | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | |
| Gomphus floccosus | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | |
| Gomphus kauffmanii | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | |
| **Rare Chanterelles** | | | | | | | | | | | | | | | | | | | | | | | |
| Cantharellus formosus | 2 | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | 2 |
| Polyozellus multiplex | | 2 | 2 | | 2 | | 2 | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| **Uncommon Coral Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Ramaria abietina | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria araiospora | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria botryis var. aurantiiramosa | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria concolor f. tsugina | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria coulterae | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria fasciculata var. sparsiramosa | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria gelatiniaurantia | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria largentii | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria rubella var. blanda | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria rubrievanescens | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria rubripermanens | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria suecica | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria thiersii | 3 | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Rare Coral Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Ramaria amyloidea | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria aurantiisiccescens | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria celerivirescens | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria claviramulata | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria concolor f. marri | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria cyaneigranosa | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |

## Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Coral Fungi (continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| Ramaria gracilis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria hilaris var. olympiana | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria lorithamnus | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria maculatipes | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria rainierensis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria rubribrunnescens | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria spinulosa | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria stuntzii | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Ramaria verlotensis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Phaeocollybia** | | | | | | | | | | | | | | | | | | | | | | | |
| Phaeocollybia attenuata | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia californica | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia carmanahensis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia dissiliens | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia fallax | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia gregaria | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia kauffmanii | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia olivacea | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia oregonensis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia piceae | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia pseudofestiva | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia scatesiae | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia sipei | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Phaeocollybia spadicea | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Uncommon Gilled Mushrooms** | | | | | | | | | | | | | | | | | | | | | | | |
| Catathelasma ventricosa | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius azureus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius boulderensis | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius cyanites | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |

**Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Uncommon Gilled Mushrooms (cont.)** | | | | | | | | | | | | | | | | | | | | | | | |
| Cortinarius magnivelatus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius olympianus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius spilomius | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius tabularis | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cortinarius valgus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Dermocybe humboldtensis | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Hebeloma olympiana | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Hygrophorus caeruleus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Hygrophorus karstenii | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Hygrophorus vernalis | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Russula mustelina | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Rare Gilled Mushrooms** | | | | | | | | | | | | | | | | | | | | | | | |
| Chroogomphus loculatus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | 3 | | | |
| Cortinarius canabarba | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | 3 | | | |
| Cortinarius rainierensis | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | 3 | | | |
| Cortinarius variipes | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | 3 | | | |
| Cortinarius verrucisporus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | 3 | | | |
| Cortinarius wiebeae | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | 3 | | | |
| Tricholoma venenatum | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | 3 | | | |
| **Uncommon Ecto-Polypores** | | | | | | | | | | | | | | | | | | | | | | | |
| Albatrellus ellisii | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 2 | 3 | 3 | | | |
| Albatrellus flettii | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 2 | 3 | 3 | | | |
| **Rare Ecto-Polypores** | | | | | | | | | | | | | | | | | | | | | | | |
| Albatrellus avellaneus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | 3 | | | |
| Albatrellus caeruleoporus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | 3 | | | |
| **Tooth Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Hydnum repandum | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | | |
| Hydnum umbilicatum | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | | |
| Phellodon atratum | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | | |
| Sarcodon fuscoindicum | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | | |
| Sarcodon imbricatus | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | | |

Errata: This information on this page was unintentionally omitted during the compilation of Appendix J2. This table should appear after page J2-61 and before page J2-62.

Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.
Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Boletes, Low Elevation** | | | | | | | | | | | | | | | | | | | | | | | |
| Boletus piperatus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 2 | 2 | 2 | | | |
| Tylopilus pseudoscaber | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 2 | 2 | 2 | | | |
| **Rare Zygomycetes** | | | | | | | | | | | | | | | | | | | | | | | |
| Endogone acrogena | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | | | | |
| Endogone oregonensis | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 6 | 3 | 3 | | 3 | |
| Glomus radiatum | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | 3 | | 3 | |
| **Uncommon Gilled Mushrooms** | | | | | | | | | | | | | | | | | | | | | | | |
| Bacospora myriadophylla | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Chrysomphalina grossula | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Collybia bakerensis | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Fayodia gracilipes (rainierensis) | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Gymnopilus puntifolius | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Marasmius applanatipes | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena hudsoniana | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena lilacifolia | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena marginella | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena monticola | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena overholtsii | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena quinaultensis | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mycena tenax | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Mythicomyces corneipes | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Neolentinus kauffmanii | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| Pholiota albivelata | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 2 | 3 | 3 | | | |
| Stagnicola perplexa | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | 3 | 2 | 2 | | | |
| **Rare Gilled Mushrooms** | | | | | | | | | | | | | | | | | | | | | | | |
| Clitocybe subditopoda | | 5 | | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clitocybe senilis | | 5 | | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Neolentinus adherens | | 5 | 5 | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Rhodocybe nitida | | 5 | 5 | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Rhodocybe speciosa | | 5 | 5 | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Tricholomopsis fulvescens | | 5 | 5 | | 3 | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Noble Polypore** | | | | | | | | | | | | | | | | | | | | | | | |
| Oxyporus nobilissimus | | 5 | 5 | | | | | | | | | | | | | | | | | | | | |

**Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Bondarzewia Polypores** | | | | | | | | | | | | | | | | | | | | | | | |
| Bondarzewia montana | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| **Rare Resupinates and Polypores** | | | | | | | | | | | | | | | | | | | | | | | |
| Aleurodiscus farlowii | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Dichostereum granulosum | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Grandinia microsporella | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Phlebia diffusa | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Polyporoletus sublividus | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Postia rennyii | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Scytinostroma cf. galatinum | 5 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | | | | |
| **Uncommon Cup Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Cudonia circinans | 3 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | 3 | |
| Cudonia monticola | 3 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | 3 | |
| Gyromitra californica | 2 | | | | | | | | | | 2 | 2 | | 2 | | | | | | | | | 3 |
| Gyromitra esculenta | 2 | | | | | | | | | | 2 | 3 | | 2 | | | | | | | | | 2 |
| Gyromitra infula | 2 | | | | | | | | | | 2 | 2 | | 2 | | | | | | | | | 3 |
| Gyromitra melaleucoides | 2 | | | | | | | | | | 2 | 2 | | 2 | | | | | | | | | 3 |
| Gyromitra montana (syn. G. gigas) | 2 | | | | | | | | | | 2 | 2 | | 2 | | | | | | | | | 3 |
| Otidea leporina | 3 | 2 | 2 | | 3 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Otidea onotica | 3 | 2 | 2 | | 3 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Otidea smithii | 3 | 2 | 2 | | 3 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Plectania melastoma | | | | | | | | | | | | | | | | | | | | | | | |
| Podostroma alutaceum | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Sarcosoma mexicana | 2 | 2 | 2 | | | | | | | | | | | | | | | 3 | | | | | 2 |
| Sarcosphaera eximia | | | | | | | | | | | | | | | | | | | | | | | |
| Spathularia flavida | 3 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 2 | 2 | | 3 | |
| **Rare Cup Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Aleuria rhenana | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | 3 | |
| Bryoglossum gracile | 3 | 5 | 5 | | | | | | | | | | | | | | 3 | | 3 | | | 3 | |
| Gelatinodiscus flavidus | 3 | 5 | 5 | | | | | | | | | | | | | | 3 | | 3 | | | | |
| Helvella compressa | 3 | 5 | 5 | | 5 | | | | | | 5 | 5 | | 5 | | | | 3 | 3 | 3 | | | |
| Helvella crassitunicata | 3 | 5 | 5 | | 5 | | | | | | 5 | 5 | | 5 | | | | 3 | 3 | 3 | | | |
| Helvella elastica | 3 | 5 | 5 | | 5 | | | | | | 5 | 5 | | 5 | | | | 3 | 3 | 3 | | | |

## Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.

Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Cup Fungi (continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| Helvella maculata | 3 | 5 | 5 | | 5 | | | | | | 5 | 5 | | 5 | | | | 3 | 3 | 3 | | | |
| Neournula pouchetii | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Pithya vulgaris | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | | | | | 3 |
| Plectania latahensis | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | | | | 3 | |
| Plectania milleri | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | | | | 3 | |
| Pseudaleuria quinaultiana | 3 | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | 3 | | 3 | |
| **Club Coral Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Clavariadelphus borealis | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus ligula | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus lovejoyae | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus pistilaris | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus sachalinensis | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus subfastigiatus | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Clavariadelphus truncatus | 3 | 3 | 3 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| **Jelly Mushroom** | | | | | | | | | | | | | | | | | | | | | | | |
| Phlogiotis helvelloides | 3 | 2 | 2 | | 2 | | | | | | 3 | 3 | | 3 | | | | | | | | | |
| **Rare Boletes** | | | | | | | | | | | | | | | | | | | | | | | |
| Boletus haematinus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Boletus pulcherrimus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Gastroboletus imbellus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 5 | |
| Gastroboletus ruber | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | 3 | | | | | 3 | |
| **Branched Coral Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Clavulina cinerea | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Clavulina cristata | 1 | | | | | | | | | | | | | | | | | | | | | | |
| Clavulina ornatipes | 1 | | | | | | | | | | | | | | | | | | | | | | |
| **Mushroom Lichen** | | | | | | | | | | | | | | | | | | | | | | | |
| Phytoconis ericetorum | 3 | | | | 3 | | | | | | 2 | 2 | | 2 | | | | | | | | | |
| **Parasitic Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Asterophora lycoperdoides | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Asterophora parasitica | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Collybia racemosa | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 6 | 3 | 3 | | | |
| Cordyceps capitata | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Cordyceps ophioglossoides | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Hypomyces luteovirens | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |

**Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**
**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Cauliflower Mushroom** | | | | | | | | | | | | | | | | | | | | | | | |
| Sparassis crispa | 3 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | 2 |
| **Moss Dwelling Mushroom** | | | | | | | | | | | | | | | | | | | | | | | |
| Cyphellostereum laeve | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Galerina atkinsoniana | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Galerina cerina | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Galerina heterocystis | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Galerina sphagnicola | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Galerina vittaeformis | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| Rickenella setipes | 3 | 2 | 2 | | 2 | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| **Coral Fungi** | | | | | | | | | | | | | | | | | | | | | | | |
| Clavicorona avellanea | 3 | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | | 3 | 3 | 3 | | | |
| **False Truffles** | | | | | | | | | | | | | | | | | | | | | | | |
| Nivatogastrium nubigenum | | 2 | 2 | | | | | | | | 2 | 3 | | 3 | | | | | | | | | |
| Rhizopogon abietis | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Rhizopogon atroviolaceus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Rhizopogon truncatus | | 2 | 2 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Thaxterogaster pingue | | 2 | 2 | | | | | | | | 2 | 2 | | 2 | | | 3 | | 2 | | | | |
| **Uncommon False Truffle** | | | | | | | | | | | | | | | | | | | | | | | |
| Macowanites chlorinosmus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | 3 | |
| **Rare False Truffles** | | | | | | | | | | | | | | | | | | | | | | | |
| Alpova alexsmithii | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Alpova olivaceotinctus | | 6 | 6 | | | | | | | | | | | | | | | | | | | | |
| Arcangeliella crassa | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Arcangeliella lactarioides | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Destuntzia fusca | | 6 | 6 | | | | | | | | 3 | 3 | | | | | | 3 | 6 | | | | |
| Destuntzia rubra | | 6 | | | | | | | | | 3 | 3 | | | | | | 3 | 6 | | | | |
| Gautieria magnicellaris | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 5 | | | 3 | |
| Gautieria otthii | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 5 | | | 3 | |
| Leucogaster citrinus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | 3 | |
| Leucogaster microsporus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Macowanites lymanensis | | 5 | 5 | | | | | | | | 3 | 3 | | | | | 3 | | 3 | | | 5 | |
| Macowanites mollis | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |

## Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare False Truffles (Continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| Martellia fragrans | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Martellia idahoensis | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Martellia monticola | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Octavianina macrospora | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 6 | | | 3 | |
| Octavianina papyracea | | 6 | | | | | | | | | 3 | 3 | | 3 | | | | 6 | 3 | | | 3 | |
| Rhizopogon brunneiniger | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | 3 | | | |
| Rhizopogon evadens var. subalpinus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Rhizopogon exiguus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 5 | | | 3 | |
| Rhizopogon flavofibrillosus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 5 | | | 3 | |
| Rhizopogon inquinatus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | 3 | |
| Sedecula pulvinata | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| **Undescribed Taxa, Rare & False Truffles** | | | | | | | | | | | | | | | | | | | | | | | |
| Alpova sp. nov. #Trappe 1966 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Alpova sp. nov. #Trappe 9730 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Arcangeliella sp. nov. #Trappe 12359 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | 3 | | 3 | |
| Arcangeliella sp. nov. #Trappe 12382 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Chamonixia pacifica sp. nov. #Trappe 12768 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 6 | 3 | | | | |
| Elaphomyces sp. nov. #Trappe 1038 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 5 | 3 | 3 | | 3 | |
| Gastroboletus sp. nov. #Trappe 2897 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Gastroboletus sp. nov. #Trappe 7515 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Gastrosuillus sp. nov. #Trappe 7516 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | 3 | | | |
| Gastrosuillus sp. nov. #Trappe 9608 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Gymnomyces sp. nov. #Trappe 1690,1706,1710 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Gymnomyces sp. nov. #Trappe 4703, 5576 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | | | 3 | |
| Gymnomyces sp. nov. #Trappe 5052 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Gymnomyces sp. nov. #Trappe 7545 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | 3 | | | |
| Hydnotrya sp. nov. #Trappe 787, 792 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | 3 |
| Hydnotrya subnix sp. nov. #Trappe 1861 | | 6 | 6 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Martellia sp. nov. #Trappe 1700 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Martellia sp. nov. #Trappe 5903 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | 3 |
| Martellia sp. nov. #Trappe 649, 311 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | | | | 3 | |
| Octavianina sp. nov. #Trappe 7502 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Rhizopogon sp. nov. #Trappe 1692 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |

## Table J2-8b Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **FUNGI** | | | | | | | | | | | | | | | | | | | | | | | |
| **Undescribed Taxa, Rare & False Truffles (cont)** | | | | | | | | | | | | | | | | | | | | | | | |
| Rhizopogon sp. nov. #Trappe 1698 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | 3 | |
| Rhizopogon sp. nov. #Trappe 9432 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | | |
| Thaxterogaster sp. nov. #Trappe 4867,6242,7427,7962,8520 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | | | 3 | |
| Tuber sp. nov. #Trappe 12493 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | | | 3 | |
| Tuber sp. nov. #Trappe 2302 | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | 3 | 3 | | | 3 | |
| **Rare Truffles** | | | | | | | | | | | | | | | | | | | | | | | |
| Balsamia nigrens | | 6 | 6 | | | | | | | | 3 | 3 | | 3 | | | | | 6 | | 3 | | |
| Choiromyces alveolatus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | 3 | | 3 | | | | |
| Choiromyces venosus | | 6 | 6 | | | | | | | | 3 | 3 | | 3 | | | | | 6 | | | | |
| Elaphomyces anthracinus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | 5 | |
| Elaphomyces subviscidus | | 5 | 5 | | | | | | | | 3 | 3 | | 3 | | | | | 3 | | | 5 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Chanterelles** | | | | | | | | | | | | | | | | | | | | | | | |
| Cantharellus cibarius | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | 2 |
| Cantharellus subalbidus | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | 2 |
| Cantharellus tubaeformis | | 2 | 2 | | | | | | | | 2 | 2 | | 3 | | | | 3 | 3 | 3 | | | 2 |

**Table J2-8c Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LICHENS** | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Forage (arboreal)** | | | | | | | | | | | | | | | | | | | | | | | |
| Bryoria tortuosa | | 5 | | | | | | | | | | | | | | | | 5 | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Oceanic Influenced** | | | | | | | | | | | | | | | | | | | | | | | |
| Cetraria californica | | 2 | 2 | | | | | | | | | 5 | | | | | | 2 | | | | 3 | |
| Heterodermia leucomelos | | 2 | 2 | | | | | | | | | 3 | | | | | | 2 | | | | 3 | |
| Loxospora sp nov. "corallifera" (Brodo in edit) | | 2 | 2 | | | | | | | | | 3 | | | | | | 2 | | | | 3 | |
| Pyrrhospora quernea | | 2 | 2 | | | | | | | | | 3 | | | | | | 2 | | | | 3 | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Leafy (arboreal)** | | | | | | | | | | | | | | | | | | | | | | | |
| Hypogymnia duplicata | | 5 | | | | | | | | | | 3 | | | | | | 5 | 3 | | | | |
| Tholurna dissimilis | | 5 | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Nitrogen-fixing** | | | | | | | | | | | | | | | | | | | | | | | |
| Dendriscocaulon intricatulum | | 5 | | | | | | | | | | 3 | | | | | 5 | | 3 | 3 | | | 3 |
| Lobaria hallii | | 5 | | | | | | | | | | 3 | | | | | | | 3 | 3 | | | 3 |
| Lobaria linita | | 5 | | | | | | | | | | 3 | | | | | 5 | | 3 | 3 | | | 3 |
| Nephroma occultum | | 5 | | | | | | | | | | 3 | | | | | 5 | | 3 | 3 | | | 3 |
| Pannaria rubiginosa | | 5 | | | | | | | | | | 3 | | | | | | | 3 | 3 | | | 3 |
| Pseudocyphellaria rainierensis | | 5 | | | | | | | | | | 3 | | | | | 5 | | 3 | 3 | | | 3 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Nitrogen-fixing** | | | | | | | | | | | | | | | | | | | | | | | |
| Lobaria oregana | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Lobaria pulmonaria | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Lobaria scrobiculata | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Nephroma bellum | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Nephroma helveticum | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Nephroma laevigatum | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Nephroma parile | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |

**Table J2-8c Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**

**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LICHENS** | | | | | | | | | | | | | | | | | | | | | | | |
| **Nitrogen-fixing (continued)** | | | | | | | | | | | | | | | | | | | | | | | |
| Nephroma resupinatum | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pannaria leucostictoides | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pannaria mediterranea | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pannaria saubinetii | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Peltigera collina | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Peltigera neckeri | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Peltigera pacifica | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pseudocyphellaria anomala | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pseudocyphellaria anthraspis | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Pseudocyphellaria crocata | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Sticta beauvoisii | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Sticta fuliginosa | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| Sticta limbata | 3 | | | | 3 | | | | 3 | | | 2 | | 3 | | | 3 | 2 | 3 | 2 | | | 3 |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Pin Lichens** | | | | | | | | | | | | | | | | | | | | | | | |
| Calicium abietinum | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Calicium adaequatum | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Calicium adspersum | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Calicium glaucellum | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Calicium viride | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenotheca brunneola | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenotheca chrysocephala | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenotheca ferruginea | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenotheca furfuracea | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenotheca subroscida | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Chaenothecopis pusilla | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Cyphelium inquinans | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Microcalicium arenarium | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Mycocalicium subtile | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Stenocybe clavata | 3 | | | | | | | | 3 | | | 2 | | | | | 3 | 3 | 3 | 2 | | | |
| Stenocybe major | 3 | | | | | | | | | | | | | | | | | | | | | | |

**Table J2-8c Level of Benefit Afforded to Individual Species or Functional Groups by the 23 Possible Mitigation Measures.**
**Refer to the Introduction of this Table and the Description of the Process for Further Explanation of Benefits and Mitigation Measures.**

| Possible Mitigation Measures | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **LICHENS** | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Rock Lichens** | | | | | | | | | | | | | | | | | | | | | | | |
| Pilophorus nigricaulis | 3 | 5 | | | | | | | | | | | | | | | | 3 | | | | | |
| Sticta arctica | 3 | 5 | | | | | | | | | | | | | | | | 3 | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Riparian Lichens** | | | | | | | | | | | | | | | | | | | | | | | |
| Cetrelia cetrarioides | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Collema nigrescens | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Leptogium burnetiae var. hirsutum | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Leptogium cyanescens | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Leptogium saturninum | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Leptogium teretiusculum | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Platismatia lacunosa | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Ramalina thrausta | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| Usnea longissima | 3 | | | | 1 | 1 | 3 | | 3 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Aquatic Lichens** | | | | | | | | | | | | | | | | | | | | | | | |
| Dermatocarpon luridum | 3 | 1 | | | 1 | 1 | | | | | | | | | | | | | | | | | |
| Hydrothyria venosa | 3 | 1 | | | 1 | 1 | | | | | | | | | | | | | | | | | |
| Leptogium rivale | 3 | 1 | | | 1 | 1 | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | |
| **Rare Oceanic Influenced** | | | | | | | | | | | | | | | | | | | | | | | |
| Bryoria pseudocapillaris | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Bryoria spiralifera | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Bryoria subcana | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Buellia oidalea | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Erioderma sorediatum | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Hypogymnia oceanica | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Leioderma sorediatum | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Leptogium brebissonii | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Niebla cephalota | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Pseudocyphellaria mougeotiana | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Teloschistes flavicans | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |
| Usnea hesperina | | 5 | 5 | | | | | | | | | 3 | | | | | | 3 | | | | 3 | |